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Development Document for Best Conventional Pollutant Control Technology Effluent Limitations Guidelines for the Pulp, Paper, and Paperboard and the Builders' Paper and Board Mills Point Source Categories

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Final

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DEVELOPMENT DOCUMENT

FOR

BEST CONVENTIONAL POLLUTANT CONTROL TECHNOLOGY
EFFLUENT LIMITATIONS GUIDELINES

FOR THE

PULP, PAPER, AND PAPERBOARD

AND THE

BUILDERS' PAPER AND BOARD MILLS
POINT SOURCE CATEGORIES

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ABSTRACT

This document presents the findings of a study of the pulp, paper, and paperboard and the builders' paper and board mills point source categories. The purpose of this study was to develop effluent limitations guidelines representing the best conventional pollutant control technology (BCT) for existing sources. These regulations were promulgated on July 9, 1986 (51 FR 24974) under the authority of Sections 301, 304, 306, 307, and 501 of the Clean Water Act (the Federal Water Pollution Control Act Amendments of 1972, 33 USC 1251 et seq., as amended by the Clean Water Act of 1977, P.L. 95-217 (the "Act")) and in response to the Settlement Agreement in Natural Resources Defense Council, Inc. v. Train, 8 ERC 2120 (D.D.C. 1976), modified, 12 ERC 1833 (D.D.C. 1979).

The information presented in this document supports the development of the BCT regulations for the pulp, paper, and paperboard and the builders' paper and board mills point source categories. Data used in the development of the BCT effluent limitations guidelines were gathered during the rulemaking efforts associated with the promulgation of best practicable control technology currently available effluent limitations guidelines (BPT), best available technology economically achievable effluent limitations guidelines (BAT), new source performance standards (NSPS), and pretreatment standards for existing and new sources (PSES and PSNS). BPT, BAT, NSPS, PSES, and PSNS were issued in November 1982. At that time, BCT effluent limitations guidelines were reserved until the promulgation of the Agency's BCT methodology. The legal authority, data gathering efforts, description of the industry, subcategorization scheme, water use and waste characterizations, and the applicable control and treatment technologies are the same for this rulemaking as for the November 1982 promulgation. Thus, this information will not be repeated in this document except where changes have occurred. The reader should refer to the following documents for this information: 1) Proposed Development Document for Effluent Limitations Guidelines and Standards for the Pulp, Paper, and Paperboard and the Builders Paper and Board Mills Point Source Categories, U.S. Environmental Protection Agency, Washington, D.C., EPA 440/1-80/025-b, December 1980, 2) Development Document for Effluent Limitations Guidelines and Standards for the Pulp, Paper, and Paperboard and the Builders' Paper and Board Mills Point Source Categories, U.S. Environmental Protection Agency, Washington, D.C., EPA 440/1-82/025; October 1982.

The reader should also refer to the documents and record supporting the promulgation of the Agency's BCT methodology (51 FR 24974).

In this document, information specific to the BCT effluent limitations guidelines is presented on the development of control and treatment options and the estimation of cost, energy, and non-water quality impacts. The methodology for the development of the effluent limitations is also presented.

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SECTION I

CONCLUSIONS

EPA is establishing effluent limitations guidelines based on the "best conventional pollutant control technology" (BCT) for the pulp, paper, and paperboard and the builders' paper and board mills point source categories as required by the Clean Water Act. This final regulation controls the discharge of five-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), and pH into waters of the United States by existing sources that produce pulp, paper, and paperboard.

BCT effluent limitations are shown in Table I-1.

Best conventional pollutant control technology limitations are established for 23 subcategories of the pulp, paper, and paperboard industry which are as follows:

40 CFR Part 430

- Subpart A - unbleached kraft,
- Subpart B - semi-chemical,
- Subpart E - paperboard from wastepaper,
- Subpart F - dissolving kraft,
- Subpart G - market bleached kraft,
- Subpart H - board, coarse, and tissue (BCT) bleached kraft,
- Subpart I - fine bleached kraft,
- Subpart J - papergrade sulfite (blow pit wash),
- Subpart K - dissolving sulfite pulp,
- Subpart N - groundwood-coarse, molded, and news (CMN) papers,
- Subpart O - groundwood-fine papers,
- Subpart P - soda,
- Subpart Q - deink,
- Subpart R - nonintegrated-fine papers,
- Subpart S - nonintegrated-tissue papers,
- Subpart T - tissue from wastepaper,
- Subpart U - papergrade sulfite (drum wash),
- Subpart V - unbleached kraft and semi-chemical (BPT limitations for mills in this subcategory are included in subpart D - unbleached kraft-neutral sulfite semi-chemical (cross recovery)),
- Subpart W - wastepaper-molded products,
- Subpart X - nonintegrated-lightweight papers,
- Subpart Y - nonintegrated-filter and nonwoven papers, and,
- Subpart Z - nonintegrated-paperboard.

TABLE I-I
BCT EFFLUENT LIMITATIONS
CONTINUOUS DISCHARGERS
(kg/kkg or lbs/1000lbs)

Subcategory	Maximum 30-Day Average		Maximum Day		pH Range[1]
	BOD5	TSS	BOD5	TSS	
Integrated Segment					
Dissolving Kraft	12.25	20.05	23.6	37.3	5.0-9.0
Market Bleached Kraft	8.05	16.4	15.45	30.4	5.0-9.0
BCT Bleached Kraft	7.1	12.9	13.65	24.0	5.0-9.0
Alkaline-Fine[2]					
o Fine Bleached Kraft	5.5	11.9	10.6	22.15	5.0-9.0
o Soda	7.1	13.2	13.7	24.5	5.0-9.0
Unbleached Kraft					
o Linerboard	2.8	6.0	5.6	12.0	6.0-9.0
o Bag	2.8	6.0	5.6	12.0	6.0-9.0
Semi-Chemical	4.35	5.5	8.7	11.0	6.0-9.0
Unbleached Kraft and Semi-Chemical	4.0	6.25	8.0	12.5	6.0-9.0
Dissolving Sulfite Pulp					
o Nitration	21.5	38.05	41.4	70.65	5.0-9.0
o Viscose	23.0	38.05	44.3	70.65	5.0-9.0
o Cellophane	24.95	38.05	48.05	70.65	5.0-9.0
o Acetate[3]					
Papergrade Sulfite (Blow Pit Wash)					
o Bisulfite-Surface	16.55	23.65	31.8	43.95	5.0-9.0
o Bisulfite-Barometric	18.05	28.1	34.7	52.2	5.0-9.0
o Acid Sulfite - Surface	16.8	23.65	32.3	43.95	5.0-9.0
o Acid Sulfite - Barometric	18.5	28.1	35.55	52.2	5.0-9.0
Papergrade Sulfite (Drum Wash)					
o Bisulfite-Surface	13.9	23.65	26.7	43.95	5.0-9.0
o Bisulfite-Barometric	15.3	28.1	29.4	52.2	5.0-9.0
o Acid Sulfite-Surface	15.5	23.65	29.75	43.95	5.0-9.0
o Acid Sulfite-Barometric	16.9	28.1	32.5	52.2	5.0-9.0
o Continuous Digesters	19.85	28.95	38.15	53.75	5.0-9.0
Groundwood-Thermo-Mechanical[4]					
Groundwood-CMN Papers	3.9	6.85	7.45	12.75	5.0-9.0
Groundwood-Fine Papers	3.6	6.3	6.85	11.75	5.0-9.0
Secondary Fibers Segment					
Deink					
o Fine Papers	9.4	12.95	18.1	24.05	5.0-9.0
o Tissue Papers	9.4	12.95	18.1	24.05	5.0-9.0
o Newsprint	9.4	12.95	18.1	24.05	5.0-9.0
Tissue From Wastepaper	7.1	9.2	13.7	17.05	5.0-9.0
Paperboard From Wastepaper					
o Corrugating Medium Furnish	2.8	4.6	5.7	9.2	6.0-9.0
o Noncorrugating Medium Furnish	1.5	2.5	3.0	5.0	6.0-9.0
Wastepaper-Molded Products	2.3	5.8	4.4	10.8	5.0-9.0
Builders' Paper and Roofing Felt[5]	3.0	3.0	5.0	5.0	6.0-9.0
Nonintegrated Segment					
Nonintegrated-Fine Papers					
o Wood Fiber Furnish	4.25	5.9	8.2	11.0	5.0-9.0
o Cotton Fiber Furnish	9.1	13.1	17.4	24.3	5.0-9.0
Nonintegrated-Tissue Papers	6.25	5.0	11.4	10.25	5.0-9.0
Nonintegrated-Lightweight Papers					
o Lightweight	13.2	10.6	24.1	21.6	5.0-9.0
o Electrical	20.9	16.7	38.0	34.2	5.0-9.0
Nonintegrated-Filter and Nonwoven Papers	16.3	13.0	29.6	26.6	5.0-9.0
Nonintegrated-Paperboard	3.6	2.8	6.5	5.8	5.0-9.0

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[1] pH shall be within the indicated range at all times.
[2] Includes fine bleached kraft and soda subcategories.
[3] BPT limitations for acetate grade production in the dissolving sulfite pulp subcategory have been remanded by the Court of Appeals. Limitations have not yet been promulgated.
[4] BCT effluent limitations for the groundwood-thermo-mechanical pulp subcategory have not yet been established.
[5] In addition to the above limitations settleable solids are not to exceed 2.0 ml/l.

40 CFR Part 431

- o Subpart A - builders' paper and roofing felt.

BCT limitations are not being established for Subpart L of 40 CFR Part 430, the groundwood-chemi-mechanical subcategory. When BAT, NSPS, PSES, and PSNS regulations were proposed and later promulgated for the pulp, paper, and paperboard industry, this subcategory was excluded from regulation under authority of paragraph 8(a)(iv) of the Revised Settlement Agreement. Because sufficient data are still unavailable for this subcategory, BCT effluent limitations for the groundwood-chemi-mechanical subcategory are not being established at this time.

BCT limitations are also not established for the groundwood-thermo-mechanical subcategory (Subpart M) because insufficient data are available to develop costs and pollutant removals for this subcategory.

BCT effluent limitations are established equal to best practicable control technology currently available (BPT) effluent limitations for each subcategory. BPT effluent limitations are based on the anticipated performance of wastewater treatment technology (either primary clarification or biological treatment) applied to raw waste loads characteristic of the subcategory or on transfer of technology performance from another subcategory.

Limitations for BOD_5 and TSS are presented in kilograms of pollutant per 1,000 kilograms of production (lb/1,000 lbs). Production shall be defined as the annual off-the-machine production (including off-the-machine coating where applicable) divided by the number of operating days during that year. Paper production shall be measured at the off-the-machine moisture content whereas market pulp shall be measured in air-dry tons (10 percent moisture). Production shall be determined for each mill based on past production rates, present trends, or committed growth. For non-continuous dischargers, maximum day effluent concentrations shall apply.

Since BCT effluent limitations guidelines are being set equal to the BPT effluent limitations guidelines for each subcategory, there are no incremental costs or non-water quality environmental impacts (including air pollution, solid waste generation, and energy requirements) associated with the final BCT regulations.

SECTION II

BACKGROUND

The Federal Water Pollution Control Act Amendments of 1972 established a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." (Section 101(a)). To implement the Act, EPA was required to issue effluent limitations guidelines, pretreatment standards, and new source performance standards for industrial dischargers.

EPA promulgated effluent limitations guidelines based on best practicable control technology currently available (BPT) and best available technology economically achievable (BAT) and also issued new source performance standards (NSPS) and pretreatment standards for existing (PSES) and new sources (PSNS) for the pulp, paper, and paperboard industry on November 18, 1982 (47 FR 52006).(4)

The 1977 amendments to the Clean Water Act added Section 301(b)(2)(E) establishing "best conventional pollutant control technology" (BCT) for discharges of conventional pollutants from existing industrial point sources. BCT is not an additional limitation but replaces BAT for the control of conventional pollutants. Conventional pollutants are those defined in Section 304(a)(4) [biochemical oxygen demand ($BOD\underline{5}$), total suspended solids (TSS), fecal coliform, and pH], and any additional pollutants defined by the Administrator as "conventional" (oil and grease, 44 FR 44501, July 30 1979).

EPA originally published a methodology for carrying out the BCT analysis on August 24, 1979 (44 FR 50732). The core of this methodology was a comparison of the costs of removing additional pounds of conventional pollutants for industry to the costs of removing conventional pollutants for an average-sized publicly owned treatment works (POTW). The 1979 methodology was challenged in the U.S. Court of Appeals for the Fourth Circuit, and on July 28, 1981, the Court issued its decision. American Paper Institute v. EPA, 660 F2d 954 (4th Cir. 1981). While upholding the methodology that EPA had developed for the POTW cost comparison test, the Court remanded the regulation to the Agency for two reasons. First, the Court held that the Clean Water Act requires EPA to consider two tests of "reasonableness" as part of the BCT methodololgy: a POTW cost-comparison test and an industry cost-effectiveness test. Since the 1979 methodology contained only the POTW cost test, the Court directed EPA to develop a separate industry cost-effectiveness test. If candidate BCT effluent limitations are not found reasonable, after evaluation of both tests, then BCT limitations will be established as equal to BPT. In no case may BCT be less stringent than BPT. Second, the Court instructed the EPA to correct certain statistical errors that had been made in

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calculating the POTW test.

The Agency proposed a revised methodology for the general development of BCT limitations on October 29, 1982 (47 FR 49176). EPA also published new cost information and announced that additional information on the development of the BCT methodology was available on September 20, 1984 (49 FR 37046). The Agency issued its final BCT methodology on July 9, 1986 (see 51 FR 24974). (3)

On January 6, 1981, EPA proposed BCT limitations for the pulp, paper, and paperboard industry (46 FR 1430); these regulations were reproposed in 1982 when the revised BCT methodology was issued in response to the American Paper Institute v. EPA decision discussed above (47 FR 49176, October 29, 1982). The final BCT limitations for the pulp, paper, and paperboard industry were developed based on the Agency's promulgated BCT methodology.

METHODOLOGY AND DATA GATHERING EFFORTS

EPA first proposed BCT limitations for the pulp, paper, and paperboard industry on January 6, 1981.(8) Prior to this proposal, a great amount of technical information was collected to develop the final BCT limitations. The methodology and data gathering activities associated with the January 1981 rulemaking are detailed in Sections III, IV, and V of the preamble to those proposed rules (46 FR 1430) and in the Proposed Development Document supporting those rules. (See references number 8 and number 1, respectively). The Agency then reproposed BCT limitations for the pulp, paper, and paperboard industry on October 29, 1982 (47 FR 49176). (6)

Following these proposals, the Agency received numerous public comments. In order to respond fully to these comments, EPA engaged in additional data gathering activities. In particular, the Agency obtained discharge monitoring reports (DMR) from Regional and State permitting authorities and collected additional conventional pollutant data under the authority of Section 308 of the Clean Water Act to update its records and broaden the existing data base. These activities are explained in the preamble to the final BPT, BAT, PSES, PSNS, and NSPS regulations for the pulp, paper, and paperboard industry (47 FR 52006; November 18, 1982) and in the Development Document supporting those rules. (References number 4 and number 2, respectively).

The Agency assessed all applicable control technologies capable of conventional pollutant removal and identified four technology options which could form the basis of BCT effluent limitations. For each option, costs and pollutant removals were estimated. The two tests in the Agency's BCT methodology were then applied to each technology option.

SECTION III

DEVELOPMENT OF CONTROL AND TREATMENT OPTIONS

INTRODUCTION

Many control and treatment technologies were discussed in the development documents supporting the January 1981 proposed rules and the November 1982 promulgated regulations. (References 1 and 2, respectively). Information was presented on the capabilities of these technologies for removal of conventional, toxic, and nonconventional pollutants from pulp, paper, and paperboard industry wastewaters. From these technologies, EPA identified alternative control and treatment options that represent a range of conventional pollutant removal capabilities and costs. This section presents the options that were considered in determining BCT effluent limitations for the pulp, paper, and paperboard industry.

IDENTIFICATION OF CANDIDATE TECHNOLOGY OPTIONS

EPA identified the following four technology options that are capable of removing significant amounts of conventional pollutants.

(A) Option 1 - Effluent limitations based on the technology on which BPT is based for each subcategory plus additional in-plant production process controls. No additional end-of-pipe technology beyond BPT is considered in this option.

(B) Option 2 - Effluent limitations based on chemically assisted clarification of BPT final effluents for all integrated and secondary fiber subcategories and for the nonintegrated-fine papers subcategory (subcategories where BPT is based on biological treatment). For the remaining nonintegrated subcategories, for which primary treatment is the basis of BPT, effluent limitations are based on biological treatment of BPT final effluents.

(C) Option 3 - Effluent limitations based on BCT Option 1 plus chemically assisted clarification of biological treatment effluent for all integrated and secondary fiber subcategories and for the nonintegrated-fine papers subcategory (subcategories where BPT is based on biological treatment). For the remaining nonintegrated subcategories, for which primary treatment is the basis of BPT, effluent limitations are based on the application of BCT Option 1 plus biological treatment of primary effluents.

(D) Option 4 - Effluent limitations based on the levels attained at best performing mills in the respective subcategories. The technologies for achieving Option 4 effluent limitations vary depending on the types of treatment systems that are employed at mills in each subcategory.

OPTION 1

BPT for the pulp, paper, and paperboard industry was generally based on the implementation of commonly employed production process controls and end-of-pipe treatment. Biological treatment was the end-of-pipe treatment for all the subcategories with the exception of the nonintegrated-tissue papers, nonintegrated-lightweight papers, nonintegrated-filter and nonwoven papers, and nonintegrated-paperboard subcategories for which BPT was based on primary treatment. The BCT Option 1 technology basis for control of conventional pollutants is the implementation of commonly employed production process controls in addition to the existing BPT end-of-pipe treatment technologies.

Through the data gathering activities described in the development documents supporting the proposed and final rules, EPA identified additional commonly employed production process controls that can further reduce raw waste loads. These controls serve as the basis for defining BCT Option 1 where raw waste loads are lower than those that form the basis of BPT effluent limitations. The controls that are generally applicable to each subcategory which form the basis of EPA's estimates of the BCT Option 1 attainment costs are presented in Tables III-1 through III-3. The production process controls and the end-of-pipe treatment systems which form the basis of BPT for each subcategory would continue to be applied.

The methodology used to develop raw waste loads and the anticipated final effluent characteristics are discussed below.

Development of Option 1 Raw Waste Loads

BCT Option 1 flows are generally based on the average discharge flow of mills where discharge flows are lower than the flows that form the basis of BPT effluent limitations. BCT Option 1 raw waste BOD_5 loads are generally based on the average raw waste BOD_5 load of mills where raw waste BOD_5 load is lower than the raw waste BOD_5 load that forms the basis of BPT effluent limitations. The discharge flows and the raw waste BOD_5 and TSS loads that form the basis of BPT effluent limitations will hereafter be referred to as the BPT flow and BPT raw waste BOD_5 and BPT raw waste TSS respectively; collectively, they will be referred to as the BPT raw waste load (RWL).

The general methodology to determine BCT Option 1 flows and BOD_5 RWL was modified slightly for mills in the alkaline-fine papers (including bleached kraft and soda subcategories), deink (fine papers and tissue papers sectors), papergrade sulfite (drum wash), and papergrade sulfite (blow pit wash) subcategories. BPT

TABLE III-1

PRODUCTION PROCESS CONTROLS IN ADDITION TO THOSE THAT FORM THE BASIS OF BPT THAT CAN BE EMPLOYED TO ACHIEVE BCT OPTIONS 1 AND 3 RAW WASTE LOADS INTEGRATED SEGMENT

	Subcategory											
Control	Dissolving Kraft	Market Bleached Kraft	BCT Bleached Kraft	Alkaline-Fine^1	Un-bleached Kraft	Semi-Chemical	Unbleached Kraft and Semi-Chemical	Dissolving Sulfite Pulp	Papergrade Sulfite^2	Ground-wood-TMP^3	Ground-wood-CMN Papers	Ground-wood-Fine Papers
1. Woodyard/Woodroom												
a. Close up or dry woodyard and barking operation	-	-	-	-	-	-	-	X	-		-	X
b. Segregate cooling water	X	X	X	X	X	X	X	X	X		X	X
2. Pulp Mill												
a. Reduce groundwood thickener overflow	-	-	-	-	-	-	-	-	-		-	X
b. Spill collection	X	X	X	X	-	-	-	X	X		X	X
3. Washers and Screen Room												
a. Add 3rd or 4th stage washer or press	X	X	X	X	X	X	X	-	X		-	-
4. Bleaching												
a. Countercurrent washing	-	-	-	X	-	-	-	-	X		-	-
b. Evaporate caustic extraction stage filtrate	-	-	-	-	-	-	-	X	-		-	-
5. Evaporation and Recovery Areas												
a. Replace barometric condenser	X	-	-	-	-	-	-	-	-		-	-
b. Add boil out tank	X	X	-	-	-	-	-	-	-		-	-
c. Segregate cooling water	-	-	-	-	-	X	-	-	-		-	-
d. Spill collection	X	X	X	X	-	-	-	-	-		-	-
e. Neutralize spent sulfite liquor (MgO mills only)	-	-	-	-	-	-	-	X	X		-	-
6. Liquor Preparation Area												
a. Spill collection	X	X	X	X	-	-	-	X	X		-	-
7. Paper Mill												
a. Spill collection:												
1. Paper machine and bleached pulp	X	X	X	X	-	-	-	X	X		X	X
2. Color plant	-	-	-	X	-	-	-	-	-		-	X

TABLE III-1
(continued)

Control	Dissolving Kraft	Market Bleached Kraft	BCT Bleached Kraft	Alkaline-Fine[1]	Un-bleached Kraft	Semi-Chemical	Unbleached Kraft and Semi-Chemical	Dissolving Sulfite Pulp	Papergrade Sulfite[2]	Ground-wood-TMP[3]	Ground-wood-CMN Papers	Ground-wood-Fine Papers
7. Paper Mill (continued)												
b. Improve saveall	-	-	-	-	-	-	-	-	-		-	-
c. High pressure showers for wire and felt cleaning	X	-	-	-	-	-	-	X	-		-	-
d. White water use for vacuum pump sealing	X	-	X	X	-	-	-	X	X		X	X
e. Paper machine white water showers for wire cleaning	-	-	-	-	-	-	-	-	-		-	-
f. White water storage for upsets and pulper dilution	-	-	-	-	-	-	-		-		X	-
g. Recycle press water	X	-	-	-	X	X	X	-	X		X	X
h. Reuse of vacuum pump water	-	-	-	X	X	X	X	X	X		X	X
i. Broke storage	-	-	-	-	-	-	-	-	-		-	-
j. Segregate cooling water	-	-	-	-	-	-	-	-	-		-	-
k. Gland water reduction	-	-	-	-	-	-	-	-	-		-	-
8. Steam Plant and Utility Areas												
a. Segregate cooling water	X	-	-	-	-	-	-	X	-		-	X
b. Lagoon for boiler blowdown and backwash waters	X	X	X	X	-	-	-	-	X		-	-
9. Miscellaneous Controls												
a. Cooling tower	-	-	-	-	-	-	-	-	-		-	-
b. Recycle of effluent	-	-	-	-	-	-	-	-	-		-	-

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[1] Includes Fine Bleached Kraft and Soda subcategories.

[2] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories.

[3] BCT has been set equal to BPT for the groundwood TMP subcategory.

TABLE III-2

PRODUCTION PROCESS CONTROLS IN ADDITION TO THOSE THAT FORM THE BASIS OF BPT THAT CAN BE EMPLOYED TO ACHIEVE BCT OPTIONS 1 AND 3 RAW WASTE LOADS SECONDARY FIBERS SEGMENT

	Subcategory				
Control	Deink	Tissue From Wastepaper	Paperboard From Wastepaper	Wastepaper-Molded Products	Builders' Paper and Roofing Felt
1. Woodyard/Woodroom					
a. Close-up or dry woodyard and barking operation	-	-	-	-	-
b. Segregate cooling water	-	-	-	-	-
2. Pulp Mill					
a. Reduce groundwood thickener overflow	-	-	-	-	-
b. Spill collection	X	-	-	-	-
3. Washers and Screen Room					
a. Add 3rd or 4th stage washer or press	-	-	-	-	-
4. Bleaching					
a. Countercurrent washing	-	-	-	-	-
b. Evaporate caustic extraction stage filtrate	-	-	-	-	-
5. Evaporation and Recovery Areas					
a. Replace barometric condenser	-	-	-	-	-
b. Add boil out tank	-	-	-	-	-
c. Segregate cooling water	-	-	-	-	-
d. Spill collection	-	-	-	-	-
6. Liquor Preparation Area					
a. Spill collection	-	-	-	-	-
7. Paper Mill					
a. Spill collection:					
1. Paper machine and bleached pulp	-	X	-	-	-
2. Color plant	-	-	-	-	-
b. Improve saveall	-	-	B	X	X
c. High pressure showers for wire and felt cleaning	X	X	B	-	-
d. White water use for vacuum pump sealing	X	X	-	-	-
e. Paper machine white water showers for wire cleaning	-	-	-	-	X
f. White water storage for upsets and pulper dilution	-	-	X	-	-
g. Recycle press water	-	X	B	-	-
h. Reuse of vacuum pump water	-	X	B	-	-
i. Broke storage	-	-	-	-	-
j. Segregate cooling water	-	-	-	-	-
k. Gland water reduction	-	-	B	-	-
8. Steam Plant and Utility Areas					
a. Segregate cooling water	X	-	-	-	-
b. Lagoon for boiler blowdown and backwash waters	X	-	-	X	-
9. Miscellaneous Controls					
a. Cooling tower	-	-	-	X	X
b. Recycle of effluent	X	X	-	X	X

B-These production process controls were erroneously included as BPT production process controls. They were included in EPA's determination of BCT Options 1 and 3 raw waste loads.

TABLE III-3

PRODUCTION PROCESS CONTROLS IN ADDITION TO THOSE THAT FORM THE BASIS OF BPT THAT CAN BE EMPLOYED TO ACHIEVE BCT OPTIONS 1 AND 3 RAW WASTE LOADS NONINTEGRATED SEGMENT

	Subcategory				
Control	Nonintegrated-Fine Papers	Nonintegrated-Tissue Papers	Nonintegrated-Lightweight Papers	Nonintegrated-Filter and Nonwoven Papers	Nonintegrated-Paperboard
1. Woodyard/Woodroom					
a. Close-up or dry woodyard and barking operation	-	-	-	-	-
b. Segregate cooling water	-	-	-	-	-
2. Pulp Mill					
a. Reduce groundwood thickener overflow	-	-	-	-	-
b. Spill collection	-	-	-	-	-
3. Washers and Screen Room					
a. Add 3rd or 4th stage washer or press	-	-	-	-	-
4. Bleaching					
a. Countercurrent washing	-	-	-	-	-
b. Evaporate caustic extraction stage filtrate	-	-	-	-	-
5. Evaporation and Recovery Areas					
a. Replace barometric condenser	-	-	-	-	-
b. Add boil out tank	-	-	-	-	-
c. Segregate cooling water	-	-	-	-	-
d. Spill collection	-	-	-	-	-
6. Liquor Preparation Area					
a. Spill collection	-	-	-	-	-
7. Paper Mill					
a. Spill collection:					
1. Paper machine and bleached pulp	X	X	-	X	-
2. Color plant	X	-	-	-	-
b. Improve saveall	-	-	X	X	-
c. High pressure showers for wire and felt cleaning	X	-	X	X	-
d. White water use for vacuum pump sealing	X	-	X	-	X
e. Paper machine white water showers for wire cleaning	-	-	-	X	X
f. White water storage for upsets and pulper dilution	-	-	X	-	-
g. Recycle press water	-	-	-	-	X
h. Reuse of vacuum pump water	X	-	-	-	X
i. Broke storage	-	-	X	-	-
j. Segregate cooling water	X	X	X	-	-
k. Gland water reduction	-	-	-	-	-
8. Steam Plant and Utility Areas					
a. Segregate cooling water	-	-	-	X	X
b. Lagoon for boiler blowdown and backwash waters	X	X	X	-	-
9. Miscellaneous Controls					
a. Cooling tower	-	-	-	-	-
b. Recycle of effluent	-	-	-	-	-

effluent limitations for mills in these subcategories were based on data representative of facilities that only manufacture products characteristic of their subcategory. However, many mills in these subcategories manufacture some products typical of other subcategories. BPT RWLs and final effluent characteristics for mills of this type are determined by first multiplying the guidelines for each appropriate subcategory by the quantity of product produced at the mill typical of that subcategory, and by then summing over all subcategories. BPT effluent characteristics and RWLs determined by this method are referred to as prorated BPT final effluent characteristics and prorated BPT RWLs, respectively.

BCT Option 1 for each of these subcategories was determined by calculating the prorated BPT flow and BOD_5 RWL for each mill. The facilities that had flows lower than their respective prorated BPT flow were identified. The percent of each mill's flow below its prorated BPT flow was determined as follows:

$$\text{percent below BPT (raw waste)} = \frac{100 \times (\text{prorated BPT flow} - \text{raw waste flow})}{\text{prorated BPT flow}}$$

The values for the "percent below BPT" of the mills in the subcategory with flows less than their respective prorated BPT flows were averaged. The subcategory BCT Option 1 flow was then calculated by decreasing the subcategory BPT flow by the average "percent below BPT" characteristic of the subcategory, as follows:

$$\text{BCT Option 1 flow} = (\text{BPT flow}) \times [1 - (\text{average percent below BPT}/100)]$$

The same procedure was followed to determine the BCT Option 1 BOD_5 RWL.

EPA is setting the BCT Option 1 TSS RWLs for all subcategories equal to the BPT TSS RWLs because 1) the TSS RWL has little effect, if any, on final effluent BOD_5 and TSS load since the TSS final effluent concentration is a function of the BOD_5 raw waste concentration, and 2) EPA wanted to ensure that the cost estimates do not understate the cost of solid waste disposal associated with primary clarification.

Because the BCT Option 1 RWLs were generally derived from actual mill data, it was not necessary to apply the estimated RWL reductions associated with the BCT Option 1 production process controls to specific subcategory BPT RWLs. However, for several subcategories, where limited actual mill data were available, it was necessary to apply these estimated RWL reductions. For these subcategories, BCT Option 1 flow and BOD_5 RWL were determined by subtracting the predicted reductions from BPT flow and BOD_5 RWL.

BCT Option 1 controls which result in RWL reductions below BPT RWLs are presented in Tables III-1 through III-3. [BPT long-term average raw waste loads (which are identical to BCT Option 2 RWLs) are shown in Table III-4.] The controls are those that can be employed at mills in each subcategory to achieve the BCT Option 1 RWLs developed from actual mill data for each subcategory (presented in Tables III-6 through III-27). It was, however, necessary to estimate the reductions associated with the process controls used in each subcategory to determine the costs of installing and operating the process controls. Table III-5 presents BCT Option 1 flows and BOD5 RWLs for subcategories where these parameters are based on actual mill data. For comparison, the flows and BOD5 RWLs predicted by subtracting the total estimated RWL reductions for each subcategory from subcategory BPT flows and BOD5 RWLs are also presented. The comparison demonstrates that the identified BCT Option 1 controls can be applied in each subcategory to achieve BCT Option 1 flow and BOD5 RWLs.

Descriptions of the specific procedures used to establish BCT Option 1 RWLs for each subcategory follow. Modifications to the general methodology are noted.

Dissolving Kraft - The dissolving kraft subcategory comprises three mills. Actual RWL data for these mills and BPT RWLs are presented in Table III-6. There are only a few mills with limited RWL data in this subcategory, and varying percentages of dissolving pulp are produced at these mills, therefore, the general methodology was not used. EPA determined BCT Option 1 RWLs by subtracting estimated flow and BOD5 RWL reductions (attainable through the implementation of the specific BCT Option 1 production process controls applicable to this subcategory) from the BPT RWL.

The BCT Option 1 production process controls identified as applicable in this subcategory are: segregate woodroom cooling water; improved brownstock washing; brownstock, recovery area, and bleached pulp spill collection; replacement of barometric condenser; addition of boil out tank; additional liquor storage; high pressure showers for wire and felt cleaning; use of white water for vacuum pump sealing; improved white water storage; segregation of steam plant cooling water; and lagoon for boiler blowdown and backwash waters. The total projected flow and BOD5 RWL reductions are 21.3 kl/kkg (5.1 kgal/t) and 6.2 kg/kkg (12.3 lb/t), respectively. Because each of these production process controls has been employed at dissolving kraft mills or other bleached kraft mills, EPA believes that these technologies can be applied at all mills in this subcategory.

TABLE III-4

BPT AND BCT OPTION 2
LONG-TERM AVERAGE RAW WASTE LOADS

	Flow		BOD5		TSS	
	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
Integrated Segment						
Dissolving Kraft	229.9	(55.1)	66.5	(133.0)	113.0	(226.0)
Market Bleached Kraft	173.6	(41.6)	38.0	(75.9)	45.0	(90.0)
BCT Bleached Kraft	147.7	(35.4)	38.4	(76.7)	66.5	(133.0)
Alkaline-Fine[1]	128.9	(30.9)	33.6	(67.2)	75.0	(150.0)
Unbleached Kraft						
o Linerboard	52.6	(12.6)	16.9	(33.8)	21.9	(43.8)
o Bag	52.6	(12.6)	23.7	(47.4)[2]	21.9	(43.8)
Semi-Chemical	43.0	(10.3)	25.2	(50.4)	12.3	(24.6)
Unbleached Kraft and Semi-Chemical	58.4	(14.0)	19.4	(38.8)	20.5	(41.0)
Dissolving Sulfite Pulp						
o Nitration	275.4	(66.0)	137.0	(274.0)	92.5	(185.0)
o Viscose	275.4	(66.0)	156.0	(312.0)	92.5	(185.0)
o Cellophane	275.4	(66.0)	181.5	(363.0)	92.5	(185.0)
o Acetate	302.1	(72.4)[3]	266.4	(532.8)[3]	92.5	(185.0)[3]
Papergrade Sulfite[4]	185.6-227.3	(44.5-54.5)	84-139.5	(168-279)	90.0	(180.0)
Groundwood-Thermo-Mechanical	88.1	(21.1)	39.2	(78.4)	39.9	(79.8)
Groundwood-CMN Papers	99.3	(23.8)	17.4	(34.8)	48.5	(97.0)
Groundwood-Fine Papers	91.4	(21.9)	16.7	(33.3)	52.5	(105.0)
Secondary Fibers Segment						
Deink						
o Fine Papers	101.8	(24.4)	90.0	(180.0)	202.5	(405.0)
o Tissue Papers	101.8	(24.4)	90.0	(180.0)	202.5	(405.0)
o Newsprint	101.8	(24.4)	90.0	(180.0)	202.5	(405.0)
Tissue From Wastepaper	105.2	(25.2)	14.5	(29.0)	110.5	(221.0)
Paperboard From Wastepaper						
o Corrugating Medium Furnish	30.0	(7.2)	23.0	(46.0)	11.0	(21.9)
o Noncorrugating Medium Furnish	30.0	(7.2)	11.3	(22.5)	11.0	(21.9)
Wastepaper-Molded Products	88.1	(21.1)	7.9	(15.8)	14.8	(29.6)
Builders' Paper and Roofing Felt	60.1	(14.4)	12.6	(25.2)	41.0	(82.0)
Nonintegrated Segment						
Nonintegrated-Fine Papers						
o Wood Fiber Furnish	63.4	(15.2)	10.8	(21.5)	30.8	(61.6)
o Cotton Fiber Furnish	176.5	(42.3)	22.9	(45.8)	55.2	(110.4)
Nonintegrated-Tissue Papers	95.6	(22.9)	11.5	(22.9)	34.7	(69.4)
Nonintegrated-Lightweight Papers						
o Lightweight	203.2	(48.7)	21.7	(43.3)	63.4	(126.8)
o Electrical	320.9	(76.9)	21.7	(43.3)	63.4	(126.8)
Nonintegrated-Filter and Nonwoven Papers	250.0	(59.9)	12.2	(24.3)	27.4	(54.7)
Nonintegrated-Paperboard	53.8	(12.9)	10.4	(20.8)	36.9	(73.7)

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[1] Includes Fine Bleached Kraft and Soda subcategories.

[2] BCT Option 2 RWL is as shown, BPT RWL BOD5 is 16.9 kg/kkg (33.8 lb/t)

[3] BPT limitations for acetate grade production in the dissolving sulfite pulp subcategory have been remanded by the Court of Appeals. As limitations have not yet been promulgated, raw waste loads (RWL) corresponding to the BPT effluent limitations have not yet been established. The RWLs shown here are representative of the RWLs associated with the production of acetate grade dissolving sulfite pulp.

[4] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories.

Table III-5
COMPARISON OF BCT OPTION 1 RAW WASTE LOADS WITH RAW WASTE LOADS PREDICTED FROM ESTIMATED REDUCTIONS BY PROCESS CONTROLS

	Flow				BOD5			
	BCT Option 1		Calculated Value		BCT Option 1		Calculated Value	
	kg/kkg	(kgal/t)	kg/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
Integrated Segment								
Dissolving Kraft	*	*	208.7	(50.0)	*	*	60.4	(120.7)
Market Bleached Kraft	154.8	(37.1)	161.5	(38.7)	31.8	(63.6)	31.7	(63.4)
BCT Bleached Kraft	123.9	(29.7)	132.7	(31.8)	35.1	(70.2)	28.6	(57.1)
Alkaline-Fine[1]	99.7[2]	(23.9[2])	102.7	(24.6)	30.4[2]	(60.8[2])	28.1	(56.1)
Unbleached Kraft								
o Linerboard	40.5	(9.7)	43.4	(10.4)	14.9	(29.8)	13.7	(27.3)
o Bag	48.0	(11.5)	43.4	(10.4)	21.9	(43.8)	20.5	(40.9)
Semi-Chemical	30.5	(7.3)	30.9	(7.4)	17.6	(35.2)	19.0	(38.0)
Unbleached Kraft and Semi-Chemical	48.0	(11.5)	49.2	(11.8)	16.3	(32.5)	17.2	(34.4)
Dissolving Sulfite Pulp[2]								
o Nitration		*	233.7	(56.0)	*	*	90.6 [64.1]	(181.2) [128.2])
o Viscose		*	233.7	(56.0)	*	*	92.6 [65.6]	(185.2) [131.2])
o Cellophane		*	233.7	(56.0)	*	*	109.6 [80.1]	(219.2) [160.2])
o Acetate		*	260.4	(62.4)	*	*	157.0 [126.5]	(314.0) [253.0])
Papergrade Sulfite[2],[3]	116.7[4]	(28.0[4])	113.9[4]	(27.3[4])	42.0 [36.7]	(83.9[4] [73.4[4]])	48.6[4] [43.4][4]	(97.2[4] [86.7[4]])
Groundwood-Thermo-Mechanical	--	(--)	--	(--)	--	(--)	--	(--)
Groundwood-CMN Papers	*	*	70.1	(16.8)	*	*	13.3	(26.6)
Groundwood-Fine Papers	64.3	(15.4)	62.6	(15.0)	12.5	(24.9)	11.7	(23.4)
Secondary Fibers Segment								
Deink								
o Fine Papers	44.2	(10.6)	59.7	(14.3)	68.9	(137.7)	([5])	([5])
o Tissue Papers	52.2	(12.5)	46.7	(11.2)	94.6	(189.2)	([5])	([5])
o Newsprint	--	(--)	--	(--)	--	(--)	--	(--)
Tissue From Wastepaper	68.0	(16.3)	69.3	(16.5)	8.7	(19.3)	7.9	(15.8)
Paperboard From Wastepaper								
o Corrugating Medium Furnish	13.4	(3.2)	16.3	(3.9)	23.0	(46.0[6])	21.7	(43.3)
o Noncorrugating Medium Furnish	13.4	(3.2)	16.3	(3.9)	11.3	(22.5[6])	9.9	(19.8)
Wastepaper-Molded Products	23.8	(5.7)	23.0	(5.5)	5.5	(10.9)	5.5	(10.9)
Builders' Paper and Roofing Felt	11.3	(2.7)	10.0	(2.4)	7.4	(14.8)	7.8	(15.6)
Nonintegrated Segment								
Nonintegrated-Fine Papers								
o Wood Fiber Furnish	39.2	(9.4)	50.9	(12.2)	7.5	(14.9)	7.0	(14.0)
o Cotton Fiber Furnish	130.2	(31.2)	160.7	(38.5)	14.0	(28.0)	19.2	(38.3)
Nonintegrated-Tissue Papers	79.7	(19.1)	87.6	(21.0)	9.0	(17.9)	8.5	(16.9)
Nonintegrated-Lightweight Papers								
o Lightweight	159.4	(38.2)	154.0	(36.9)	13.3	(26.6)	17.2	(34.3)
o Electrical	278.8	(66.8)	267.9	(64.2)	13.3	(26.6)	17.2	(34.3)
Nonintegrated-Filter and Nonwoven Papers	198.2	(47.5)	209.5	(50.2)	9.0	(17.9)	9.6	(19.1)
Nonintegrated-Paperboard	46.7	(11.2)	37.6	(9.0)	8.4	(16.4)	9.7	(19.4)

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[1] Includes Fine Bleached Kraft and Soda subcategories.

[2] Values in brackets are for mills which employ MgO. Neutralization of spent sulfite liquor is a BCT Option 1 internal control for mills employing MgO, with consequently greater reductions in BOD5.

[3] Includes Papergrade Sulfite Blow Pit Wash and Papergrade Sulfite Drum Wash subcategories.

[4] BCT Option 1 flow and BOD5, and the calculated values vary with the percent sulfite pulp in the final product. Raw waste loads shown are for a model mill where on-site papergrade pulp production is 52.7 percent of the total product.

[5] An estimate is not possible for this subcategory because the BPT effluent levels do not appear to reflect correctly the actual average discharge levels.

[6] BCT Option 1 raw waste BOD5 = BPT raw waste BOD5.

* BCT Option 1 for these subcategories is assumed to be equal to the calculated values.

TABLE III-6

SUMMARY RAW WASTE LOAD DATA
DISSOLVING KRAFT SUBCATEGORY

Production Profile			Raw Waste Load					
			Flow		BOD5		TSS	
Mill No.	Raw Material	Pulp (%)(a) Dissolving	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
032001(b)	100% HW	68.7	136.9	(32.8)	109.5	(219.0)	120.4	(240.7)
032002(b)	100% SW	44.8	218.2	(52.3)	39.4	(78.7)	132.0	(264.0)
032003(b)	88% SW	59.0	239.1	(57.3)	59.8	(119.6)	81.6	(163.2)
Average		57.5						
BPT Raw Waste Load			230.0	(55.1)	66.5	(133.0)	113.0	(226.0)

(a) (dissolving kraft pulp)/(dissolving kraft pulp & market bleached kraft pulp)

(b) Production data held confidential.

The resulting BCT Option 1 flow and BOD5 RWL are presented below:

Dissolving Kraft - Development of Option 1 Raw Waste Loads

	Flow kl/kkg (kgal/t)	BOD5 kg/kkg (lb/t)
BPT RWL	230.0 (55.1)	66.5 (133.0)
Reductions resulting from application of specific production process controls	21.3 (5.1)	6.2 (12.3)
Option 1 RWL	208.7 (50.0)	60.4 (120.7)

The BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [113.0 kg/kkg (226.0 lb/t)].

Market Bleached Kraft - Data presented in Table III-7 for the production of both bleached hardwood kraft (HWK) and bleached softwood kraft (SWK) pulp are arranged in order of increasing softwood pulp production. Of the mills where RWLs are lower than or equal to those used to develop BPT, BOD5 RWL is essentially the same at both hardwood and softwood mills. However, mills where bleached softwood pulp is produced have a higher average flow. The average flows for softwood and hardwood mills where flows are less than BPT flow are 152.7 kl/kkg (36.6 kgal/t) and 120.6 kl/kkg (28.9 kgal/t), respectively. The higher flow, 152.7 kl/kkg (36.6 kgal/t), has been chosen as representative of the subcategory. This approach gives an adequate allowance for all types of market kraft mills: hardwood, softwood, and mixtures of both. The average BOD5 RWLs for softwood and hardwood mills where BOD5 RWLs are less than the BPT RWL are 29.3 kg/kkg (58.6 lb/t) and 26.6 kg/kkg (53.2 lb/t), respectively. Since the data for both types of wood pulps are substantially the same, the higher BOD5 RWL, 29.3 kg/kkg (58.6 lb/t), is chosen.

To obtain BCT Option 1 flow and BOD5 RWL, adjustments had to be made to the average flow and BOD5 RWL of mills where discharges were lower than BPT flow and BOD5 RWL because some facilities utilized control technologies not considered as BCT Option 1 candidates by EPA. The reuse of evaporator and blow condensates is not a recommended BCT Option 1 production process control because of possible air pollutant emissions. However, many mills in the market bleached kraft subcategory use this control and their RWLs reflect the use of this control. EPA estimates that the use of this control by mills in this subcategory results in flow and BOD5 RWL reductions of 2.1 kl/kkg (0.5 kgal/t) and 2.5 kg/kkg (5.0 lb/t), respectively. These reduction values were added to the average flow and BOD5 RWL of mills using this

TABLE III-7

SUMMARY RAW WASTE LOAD DATA
MARKET BLEACHED KRAFT SUBCATEGORY

	Production Profile				Raw Waste Load						
	Pulp				Flow		BOD5		TSS		
Mill No.	HWK(%)	SWK(%)	Product	(t/d)	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	≤BPT(c)
030005	100	-	bales	369	73.4	(17.6)	17.5	(35.0)	20.4	(40.8)	BF
030009	100	-	bales	592	135.2	(32.4)	--	(--)	--	(--)	F
030012	89	11	bales	(a)	153.1	(36.7)	35.7	(71.4)	98.0	(195.9)	BF
030042	64	36	slush	409	78.5	(18.8)	37.4	(74.8)	14.4	(28.7)	BF
030028	27	73	board/ bales	(a)	154.4	(37.0)	35.5	(71.0)	24.0	(47.9)	BF
030031	26	74	bales	341	333.0	(79.8)	44.0	(88.0)	132.0	(264.0)	
030030	21	79	bales	723	169.4	(40.6)	44.1	(88.1)	24.7	(49.4)	F
030018	11	89	bales	(a)	184.9	(44.3)	39.2	(78.3)	48.4	(96.8)	
030006	0	100	bales	582	179.9	(43.1)	41.3	(82.5)	22.4	(44.7)	
900074(b)	0	100	unknown	515	134.8	(32.3)	23.1	(46.2)	18.7	(37.4)	BF
Average					159.8	(38.3)	35.3	(70.6)	44.8	(89.5)	
BPT Raw Waste Load					173.0	(41.6)	38.0	(75.9)	45.0	(90.0)	
Average of Mills with ≤BPT flow					128.5	(30.8)	32.2	(64.4)	33.4	(66.7)	
Average of Mills >70% SWK					192.8	(46.2)	37.9	(75.7)	45.0	(90.0)	
Average of Mills >70% SWK and ≤BPT flow					152.7	(36.6)	34.2	(68.4)	22.5	(44.9)	
Average of Mills >70% HWK					120.6	(28.9)	26.6	(53.2)	59.2	(118.4)	
Average of Mills >70% HWK and ≤BPT flow					120.6	(28.9)	26.6	(53.2)	59.2	(118.4)	
Average of Mills >70% HWK and ≤BPT BOD5					120.6	(28.9)	26.6	(53.2)	59.2	(118.4)	
Average of Mills >70% SWK and ≤BPT BOD5					144.8	(34.7)	29.3	(58.6)	21.4	(42.7)	

(a)Production data held confidential.
(b)Supplemental data (not from 308).
(c)F - Mill with ≤BPT flow; B - Mill with ≤BPT BOD5.

control with flow or BOD5 RWL less than the BPT RWL to obtain values for BCT Option 1 flow and BOD5 RWLs that do not reflect the use of this control. The values so obtained are 154.8 kl/kkg (37.1 kgal/t) and 31.8 kg/kkg (63.6 lb/t) for flow and BOD5, respectively. This adjustment was made solely to obtain BCT Option 1 RWLs. To identify the mills with flow or BOD5 RWL less than BPT flow or BOD5 RWL, EPA compared unadjusted mill RWLs to BPT RWLs which are also unadjusted.

The BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL. In summary, the BCT Option 1 RWL's for the market bleached kraft subcategory are: flow - 154.8 kl/kkg (37.1 kgal/t), BOD5 - 31.8 kg/kkg (63.6 lb/t), and TSS - 45.0 kg/kkg (90.0 lb/t).

BCT (Paperboard, Coarse, and Tissue) Bleached Kraft - RWL data for bleached kraft mills where paperboard, coarse papers, and tissue papers are manufactured are presented in Table III-8. Of the eight mills for which data are presented, five are achieving flows and three are achieving BOD5 RWLs that are less than BPT RWL. For one of the mills (030039) attaining a lower flow and BOD5 RWL, data correspond to biological treatment plant influent rather than to a true raw waste. Therefore, the BOD5 data from this mill were not used to determine BCT Option 1 BOD5 RWL. BCT Option 1 flow and BOD5 RWL for this subcategory are the average of those mills where RWLs lower than BPT RWLs are attained. Application of this methodology yields BCT Option 1 flow and BOD5 RWLs of 123.9 kl/kkg (29.7 kgal/t) and 35.1 kg/kkg (70.2 lb/t). The BCT Option 1 TSS RWL is assumed to be the same as the BPT RWL, or 66.5 kg/kkg (133.0 lb/t) of product.

Alkaline-Fine (Fine Bleached Kraft and Soda Subcategories) - Mills in the alkaline fine bleached kraft subcategory manufacture fine papers and often a small amount of market bleached kraft pulp, primarily from a furnish consisting of bleached kraft (or soda) pulp and frequently from some purchased pulp. Four mills in this subcategory also manufacture a small amount of groundwood pulp from which they make fine papers.

The BPT BOD5 RWLs for these subcategories were adjusted to represent the raw waste loads of mills producing only fine papers from alkaline pulp manufactured on-site. The methodology used to develop BPT RWLs and effluent guidelines can be found on pages 233-238 in the development document supporting the Phase II BPT regulations promulgated in January 1977. (9)

BCT Option 1 RWLs for this subcategory were determined by comparing individual mill flow and BOD5 RWLs to their respective prorated BPT flow and BOD5 RWLs as described above. Data are presented in Table III-9 for 20 mills characteristic of the fine bleached kraft subcategory. The nine mills with flows less than their respective prorated BPT flows have flows that average 24.2 percent less than their prorated BPT flows. The seven mills with BOD5 RWLs less than their respective prorated BPT BOD5 have BOD5 RWLs that average 16.2 percent less than their prorated BPT BOD5 RWLs. The resulting flow and BOD5 RWLs, determined by reducing

TABLE III-8

SUMMARY RAW WASTE LOAD DATA
BCT BLEACHED KRAFT SUBCATEGORY

	Production Profile						Raw Waste Load						
	Pulp (t/d)		Product (t/d)				Flow		BOD5		TSS		
Mill No.	HW	SW	Board	Tissue	Coarse	Total	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	≤BPT(d)
030004	436	535	548	343	69	960	187.0	(44.8)	57.3	(114.6)	41.7	(83.3)	
030010	--	335	--	231	84	315	187.0	(44.8)	37.2	(74.4)	42.9	(85.7)	B
030022	352	943	907	--	394(c)	1301	150.6	(36.1)	33.0	(66.0)	--	(--)	B
030024	512	368	714	--	106	820	137.7	(33.0)	57.6	(115.1)	--	(--)	F
030026(a)	--	1073	884	59	210	1152	121.0	(29.0)	44.1	(88.2)	33.2	(66.3)	F
030047	306	204	583	--	--	583	131.4	(31.5)	64.1	(128.2)	79.5	(159.0)	F
030032	584	576	895	--	348	1243	138.1	(33.1)	42.6	(85.2)	48.3	(96.5)	F
030039(b)	291	238	487	--	107	594	92.2	(22.1)	29.2	(58.4)	24.0	(47.9)	F
Average							143.3	(34.3)	48.0	(96.0)	49.1	(98.2)	
BPT Raw Waste Load							148.0	(35.4)	38.4	(76.7)	66.5	(133.0)	
Average of Mills with ≤BPT flow							123.9	(29.7)	52.1	(104.2)	53.7	(107.3)	
Average of Mills with ≤BPT BOD5							169.0	(40.5)	35.1	(70.2)	42.9	(85.7)	

(a)Includes lumber mill effluent in raw waste figures.
(b)Waste load data reported are secondary influent; BOD5 and TSS are not included in averages.
(c)236 t/d market, 158 t/d writing and related papers.
(d)F - Mill with ≤BPT flow; B - Mill with ≤BPT BOD5.

TABLE III-9

SUMMARY RAW WASTE LOAD DATA
ALKALINE-FINE
(FINE BLEACHED KRAFT AND SODA SUBCATEGORIES)

	Production Profile									Raw Waste Load											
	Pulp (t/d)				Product (t/d)					Flow				BOD5						TSS	
										Prorated BPT(c)		Long-term Average		%≤ Prorated	Prorated BPT(c)		Long-term Average		%≤ Prorated	Long-term Average	
Mill No.	Alk (a)	Pch (a)	GWD (a)	UBK (a)	ALK (b)	GWD (b)	Mkt (b)	UBK (b)	Total	kl/kkg	(kgal/t)	kl/kkg	(kgal/t)	BPT(A)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	BPT(A)	kg/kkg	(lb/t)
030001	136	33	--	--	190	--	1	--	191	116.4	(27.9)	101.8	(24.4)	12.2	29.1	(58.2)	22.7	(45.4)	22.0	46.8	(93.5)
030013	275	179	--	--	510	--	--	--	510	103.1	(24.7)	122.7	(29.4)		24.6	(49.2)	--	--		--	--
030015	247	56	--	--	370	--	--	--	370	121.8	(29.2)	165.7	(39.7)		31.1	(62.2)	51.0	(101.9)		80.0	(160.0)
030020	174	145	--	--	400	--	17	--	417	100.6	(24.1)	116.0	(27.8)		23.2	(46.5)	25.5	(51.0)		78.5	(157.0)
030027	491	96	--	--	682	--	--	--	682	119.8	(28.7)	81.0	(19.4)	32.4	30.4	(60.7)	24.1	(48.2)	20.6	36.9	(73.8)
030033	680	28	130	89	242	412	101	83	838	146.5	(35.1)	139.4	(33.4)	5.1	32.1	(64.2)	75.4	(150.7)		--	--
030034	450	90	--	--	708	--	--	--	708	118.1	(28.3)	119.3	(28.6)		29.8	(59.5)	--	--		--	--
030037	925	162	--	--	1028	--	--	--	1028	119.3	(28.6)	118.5	(28.4)	0.7	30.2	(60.4)	--	--		--	--
030045	671	21	72	--	--	938	18	--	963	198.6	(47.6)	111.4	(26.7)	43.9	40.2	(80.3)	31.5	(63.0)	21.5	89.8	(179.6)
030046	640	4	--	--	691	--	50	--	741	131.4	(31.5)	132.7	(31.8)		33.8	(67.5)	31.2	(62.3)	7.7	80.4	(160.8)
030048	730	194	55	--	504	205	254	--	956	147.7	(35.4)	148.6	(35.6)		33.2	(66.3)	65.2	(130.4)		126.2	(252.3)
030049	678	42	--	--	1178	--	--	--	1178	125.2	(30.0)	72.6	(17.4)	42.0	32.3	(64.7)	21.6	(43.1)	33.4	55.0	(109.9)
030051	331	194	--	--	524	--	88	--	612	110.6	(26.5)	93.9	(22.5)	15.1	25.6	(51.1)	32.7	(65.3)		40.9	(81.7)
030052	548	72	--	--	600	--	87	--	687	126.9	(30.4)	133.5	(32.0)		31.4	(62.9)	--	--		--	--
030057	181	132	--	--	378	--	--	--	378	101.4	(24.3)	106.8	(25.6)		24.0	(47.9)	39.9	(79.8)		79.3	(158.5)
030058	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	154.4	(37.0)	115.6	(27.7)	25.1	32.8	(65.6)	31.0	(62.0)	5.5	78.9	(157.8)
030059	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	98.5	(23.6)	122.7	(29.4)		23.0	(45.9)	39.1	(78.1)		147.5	(295.0)
030060	(d)	(d)	--	(d)	(d)	(d)	(d)	(d)	(d)	104.7	(25.1)	163.6	(39.2)		26.2	(52.4)	39.2	(78.4)		101.7	(203.3)
130001	535	197	--	--	458	--	233	--	691	126.9	(30.4)	74.3	(17.8)	41.4	29.0	(58.1)	39.8	(79.5)		23.7	(47.4)
130002	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	101.8	(24.4)	107.7	(25.8)		24.1	(48.2)	23.5	(47.0)	2.5	115.2	(230.3)
Average														24.2					16.2		
BPT Raw Waste Load												120.0	(30.9)				33.6	(67.2)		75.0	(150.0)
BCT Option 1 = BPT (1 - Ave % less than BPT/100)												30.9x(1-0.242)					67.2x(1-0.162)				(150.0)

(a) Alk - alkaline pulp; Pch - purchased pulp and broke; GWD - ground wood pulp; UBK - unbleached kraft pulp.
(b) Alk - alkaline fine papers; GWD - fine papers from ground wood, alkaline and purchased pulps; Mkt - market pulp; UBK - products from unbleached kraft pulp.
(c) Prorated BPT is based on the percentage of different pulps in each mill's furnish. Prorated BPT (for flow/BOD5/TSS) = (BPT for Alk. pulp) x (% Alk. pulp) + (BPT for NI-fine papers) (% purchased pulp) + (BPT for Mkt pulp) x (% Mkt pulp) + etc.
(d) Production data held confidential.

(A) % ≤ (percent less than) prorated BPT = 100 x (prorated BPT - long-term average)/prorated BPT

BPT flow and BOD5 RWL by 24.2 percent and 16.2 percent, are 97.6 kl/kkg (23.4 kgal/t) and 28.2 kg/kkg (56.3 lb/t). A further adjustment was made to these values to obtain the BCT Option 1 flow and BOD5 RWLs. Because of possible air pollutant emissions, the reuse of evaporator and blow condensates is not a recommended BPT Option 1 production process control. However, many mills in the bleached kraft subcategory use this control and RWLs loads reflect the use of the control. EPA estimates that use of this control by mills in these subcategories results in flow and BOD5 RWL reductions of 2.1 kl/kkg (0.5 kgal/t) and 2.3 kg/kkg (4.5 lb/t), respectively. These reduction values were added to the flow and BOD5 RWLs developed above to obtain values for BCT Option 1 flow and BOD5 RWLs that do not reflect the use of this control. The values obtained are 99.7 kl/kkg (23.9 kgal/t) and 30.4 kg/kkg (60.8 lb/t) for flow and BOD5.

EPA identified the mills with flow or BOD5 RWLs less than BPT BOD5 RWLs by comparing unadjusted mill RWLs to BPT RWLs which are also unadjusted. The BCT Option 1 TSS RWL is assumed to be the same as BPT, TSS RWL [75.0 kg/kkg (150.0 lb/t)].

Unbleached Kraft - Data are presented in Table III-10 for mills characteristic of this subcategory. In the development of BPT effluent limitations guidelines, the unbleached kraft subcategory included mills manufacturing unbleached kraft linerboard, bag, and/or other mixed products. Data provided in response to the data request program suggest that there are differences between waste characteristics of mills manufacturing linerboard and those manufacturing bag or other mixed products. Therefore, the unbleached kraft subcategory was divided into three sectors: 1) mills that manufacture more than 90 percent linerboard; 2) mills that manufacture more than 90 percent bag and other products; and 3) mills that manufacture substantial fractions of both linerboard and bag and other products (but less than or equal to 90 percent of either). The following summarizes the subcategory averages for the first two sectors.

Unbleached Kraft-Raw Waste Load Summary

	Flow		BOD5		TSS	
	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
Unbleached Kraft-Linerboard	47.6	(11.4)	16.5	(32.9)	15.7	(31.4)
Unbleached Kraft-Bag and Other Products	77.6	(18.6)	23.7	(47.4)	15.7	(31.3)

TABLE III-10

SUMMARY RAW WASTE LOAD DATA
UNBLEACHED KRAFT SUBCATEGORY

	Production Profile							Raw Waste Load						
	Furnish(t/d)			Product (t/d)				Flow		BOD5		TSS		
Mill No.	Kraft	WP	Purch Broke	Linerboard	Bag	Other	Total	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	≤BPT (b)
Linerboard (>90% linerboard)														
010001	450	--	20	450	--	--	450	46.3	(11.1)	8.3	(16.5)	26.9	(53.7)	BF
010002	923	--	--	934	--	--	934	44.2	(10.6)	14.1	(28.2)	24.7	(49.4)	BF
010018	1,170	30	--	1,081	--	--	1,081	44.2	(10.6)	18.1	(36.1)	14.1	(28.2)	F
010019	1,127	39	27	1,144	--	7	1,151	35.1	(8.4)	9.6	(19.1)	4.8	(9.6)	BF
010020	971	55	61	965	--	44	1,009	81.0	(19.4)	20.5	(41.0)	27.6	(55.1)	
010025	523	39	--	563	--	4	567	44.7	(10.7)	13.9	(27.8)	9.8	(19.6)	BF
010038	750	68	5	789	--	--	789	105.2	(25.2)	16.5	(32.9)	15.9	(31.7)	B
010040	1,195	85	--	1,220	--	--	1,220	65.1	(15.6)	14.7	(29.4)	11.4	(22.7)	B
010042	965	--	--	965	--	--	965	23.0	(5.5)	11.1	(22.2)	5.7	(11.3)	BF
010043	1,539	10	--	1,549	--	--	1,549	44.2	(10.6)	21.7	(43.4)	13.9	(27.7)	F
010046	1,176	--	27	1,102	--	21	1,123	49.2	(11.8)	14.4	(28.7)	20.1	(40.2)	BF
010047	1,299	--	--	1,194	--	--	1,194	26.3	(6.3)	6.7	(13.4)	10.8	(21.5)	BF
010057	540	--	85	620	--	--	620	38.4	(9.2)	--	(--)	--	(--)	F
010063	(a)	(a)	(a)	(a)	(a)	(a)	(a)	31.7	(7.6)	46.3	(92.6)	9.9	(19.8)	F
010064	664	51	--	666	--	--	666	34.2	(8.2)	14.8	(29.6)	24.3	(48.6)	BF
Average								47.6	(11.4)	16.5	(32.9)	15.7	(31.4)	
BPT Raw Waste Load								52.5	(12.6)	16.9	(33.8)	21.9	(43.8)	
Average of Mills with ≤BPT flow								38.5	(9.2)	16.3	(32.5)	15.0	(30.0)	
Average of Mills with ≤BPT BOD5								47.2	(11.3)	12.4	(24.8)	15.4	(30.8)	
Bag and Other Products (>90≤% bag and other products)														
010003	243	12	--	--	283	--	283	42.1	(10.1)	--	(--)	--	(--)	F
010028	400	10	--	25	279	95	399	110.2	(26.4)	--	(--)	13.3	(26.6)	
010032	(a)	(a)	(a)	(a)	(a)	(a)	(a)	47.2	(11.3)	18.3	(36.5)	17.4	(34.8)	BF
010033	(a)	(a)	(a)	(a)	(a)	(a)	(a)	48.4	(11.6)	25.6	(51.2)	--	(--)	F
010055	748	2	12	--	726	--	726	58.4	(14.0)	30.5	(60.9)	23.2	(46.4)	
010060(c)	470	--	25	--	443	--	443	85.1	(20.4)	--	(--)	--	(--)	
010062	231	--	10	--	234	--	234	151.5	(36.3)	20.6	(41.1)	8.6	(17.2)	B
Average								77.6	(18.6)	23.7	(47.4)	15.6	(31.2)	
BPT Raw Waste Load								52.5	(12.6)	16.9	(33.8)	21.9	(43.8)	
Assumed BPT Raw Waste Load								52.5	(12.6)	23.7	(47.4)	21.9	(43.8)	
Average of Mills with ≤BPT flow								45.9	(11.0)	22.0	(43.9)	17.4	(34.8)	
Average of Mills with ≤ Assumed BPT BOD5								99.3	(23.8)	19.4	(38.8)	13.0	(26.0)	
Mixed Products (≥10% linerboard and ≥10% bag and other products) (d)														
010005	1,286	--	8	898	332	--	1,230	66.4	(15.9)	20.3	(40.6)	20.5	(40.9)	
010006	1,685	--	51	1,115	478	--	1,594	52.6	(12.6)	12.5	(25.0)	--	(--)	
010008	1,895	--	--	1,540	434	--	1,974	73.9	(17.7)	18.8	(37.6)	45.7	(91.3)	
010034	940	--	48	404	453	68	925	94.7	(22.7)	36.8	(73.5)	24.3	(48.6)	
010044	1,020	--	82	362	712	--	1,074	57.2	(13.7)	12.5	(24.9)	17.8	(35.6)	
Average								69.0	(16.5)	20.2	(40.3)	27.2	(54.1)	

(a)Production data held confidential.

(b)F - Mill with ≤BPT flow; B - Mill with ≤ Assumed BPT BOD5.

(c)Mill now closed.

(d)For purposes of costing, mills in this product sector were assigned to the linerboard or the bag and other product sectors in accordance with the majority of their products.

In establishing BCT Option 1 RWLs, EPA evaluated data for both the linerboard and bag sectors. BCT Option 1 RWLs for both sectors are based on the averages of those mills attaining RWLs lower than BPT RWLs. The average values for flow and BOD5 obtained by the application of this methodology are 38.4 kl/kkg (9.2 kgal/t) and 12.4 kg/kkg (24.8 lb/t) for the unbleached kraft-linerboard sector and 45.9 kl/kkg (11.0 kgal/t) and 19.4 kg/kkg (38.8 lb/t) for the unbleached kraft-bag and other product sector.

To obtain BCT Option 1 flows and BOD5 RWLs for the linerboard sector and the bag and other products sector, adjustments were made to the average flow and BOD5 RWLs of mills where discharges were lower than BPT flow and BOD5 RWLs because of the use of control technologies not considered by EPA to be BCT Option 1 candidates. Because of possible air pollutant emissions, the reuse of evaporator and blow condensates is not a recommended BCT Option 1 production process control. However, many mills in all sectors of the unbleached kraft subcategory use this control and their RWLs reflect the use of this control. EPA estimates that the use of this control by mills in this subcategory results in flow and BOD5 RWL reductions of 2.1 kl/kkg (0.5 kgal/t) and 2.5 kg/kkg (5.0 lb/t) for mills in each sector. These reduction values were added to the average flow and BOD5 RWLs of mills with flow or BOD5 RWLs less than BPT RWLs to obtain values for BCT Option 1 flow and BOD5 RWLs that do not reflect the use of the control. The values obtained are 40.5 kl/kkg (9.7 kgal/t) and 14.9 kg/kkg) (29.8 lb/t) for flow and BOD5 for the linerboard sector, and 48.0 kl/kkg (11.5 kgal/t) and 21.9 kg/kkg (43.8 lb/t) for flow and BOD5 for the bag and other products sector.

To identify the mills with flow or BOD5 RWLs less than BPT, EPA compared unadjusted mill RWLs to BPT RWLs which are also unadjusted. The BCT Option 1 TSS RWLs for both sectors are equal and are assumed to be the same as the BPT TSS RWL [21.9 kg/kkg (43.8 lb/t)].

Semi-Chemical - Available RWL data for semi-chemical mills are presented in Table III-11. The data are presented according to wastepaper use and use of liquor recovery. Variable amounts of wastepaper are utilized at mills in this subcategory according to relative market conditions and pricing. Because of this variation, two mill groups were considered in the development of BCT Option 1 RWLs. The groups are: (a) mills with liquor recovery where less than one-third of the furnish is wastepaper and (b) mills with liquor recovery where more than one-third of the furnish is wastepaper. Review of the data in Table III-10 indicates a significant difference in the average flows of the two groups [35.9 kl/kkg (8.6 kgal/t) versus 18.8 kl/kkg (4.5 kgal/t)] but no significant difference in the average BOD5 RWLs [22.1 kg/kkg (44.1 lb/t) versus 23.9 kg/kkg (47.8 lb/t)]. Therefore, the BCT Option 1 flow is based on the average of those mills with liquor recovery where less than one-third wastepaper is processed and a flow lower than BPT flow is attained. The BCT Option 1 BOD5 RWL is the average BOD5 RWL of both groups of mills

TABLE III-11

SUMMARY RAW WASTE LOAD DATA
SEMI-CHEMICAL SUBCATEGORY

	Production Profile						Raw Waste Load				
	Furnish (t/d)			Product	Flow		BOD5		TSS		
Mill No.	Semi-Chem	WP	Broke	(t/d)	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	≤BPT(a)
I. Mills With Liquor Recovery and Less Than 1/3 WP											
020002	248	90	20	331	24.2	(5.8)	12.9	(25.7)	30.2	(60.4)	BF
020003(b)	582	61	--	618	40.1	(9.6)	25.3	(50.5)	13.2	(26.3)	F
020008(b)	231	125	--	318	23.0	(5.5)	9.6	(19.2)	6.9	(13.7)	BF
020009(b)	(c)	(c)	(c)	(c)	28.8	(6.9)	14.4	(28.8)	17.8	(35.6)	BF
020010	(c)	(c)	(c)	(c)	60.5	(14.5)	17.9	(35.7)	49.3	(98.5)	B
020013	472	173	--	599	39.6	(9.5)	39.0	(77.9)	37.8	(75.5)	F
020014(d)	394	117	--	511	26.7	(6.4)	31.2	(62.3)	18.8	(37.6)	F
020017	(c)	(c)	(c)	(c)	30.5	(7.3)	20.7	(41.3)	44.5	(89.0)	BF
060004(b)	385	98	9	492	48.8	(11.7)	27.8	(55.6)	54.6	(109.2)	
Average					35.9	(8.6)	22.1	(44.1)	30.3	(60.6)	
BPT Raw Waste Load					42.9	(10.3)	25.2	(50.4)	12.3	(24.6)	
Average of Mills with ≤BPT flow					30.5	(7.3)	21.9	(43.7)	24.2	(48.3)	
Average of Mills with ≤BPT BOD5					33.4	(8.0)	15.1	(30.1)	29.7	(59.4)	
II. Mills With Liquor Recovery and More Than 1/3 WP											
020001	204	116	--	302	19.2	(4.6)	23.6	(47.1)	8.1	(16.1)	BF
020004(e)	160	106	--	266	25.0	(6.0)	1.3	(2.6)	0.2	(0.3)	
020006	190	99	--	291	16.3	(3.9)	24.2	(48.4)	--	(--)	BF
020007	183	123	--	346	10.4	(2.5)	--	(--)	--	(--)	F
020011(f)	235	157	--	377	34.2	(8.2)	22.6	(45.2)	6.0	(11.9)	
020012	(c)	(c)	(c)	(c)	28.4	(6.8)	--	(--)	--	(--)	F
Average					18.8	(4.5)	23.9	(47.8)	8.1	(16.1)	
BPT Raw Waste Load					42.9	(10.3)	25.2	(50.4)	12.3	(24.6)	
Average of Mills with ≤BPT flow					18.8	(4.5)	23.9	(47.8)	8.1	(16.1)	
Average of Mills with ≤BPT BOD5					17.9	(4.3)	23.9	(47.8)	8.1	(16.1)	
III. Mills Without Liquor Recovery											
020005	137	46	--	183	47.2	(11.3)	56.1	(112.1)	52.4	(104.7)	
020015	118	50	--	169	20.4	(4.9)	33.2	(66.4)	27.9	(55.7)	F
Average					33.8	(8.1)	44.7	(89.3)	40.1	(80.2)	
IV. Non Representative Mills											
020018(g)	217	450	--	673	30.5	(7.3)	62.8	(125.6)	61.5	(123.0)	F
020016(g)	200	221	--	525	55.5	(13.3)	50.5	(100.9)	42.2	(84.3)	
Average					43.0	(10.3)	56.7	(113.3)	51.9	(103.7)	
Average of All Mills					30.9	(7.4)	25.8	(51.6)	30.1	(60.2)	
BPT Raw Waste Load					42.9	(10.3)	25.2	(50.4)	12.3	(24.6)	
Average of Mills with ≤BPT flow (Group I and II)					26.3	(6.3)	22.3	(44.6)	22.2	(44.3)	
Average of Mills with ≤BPT BOD5 (Group I and II)					28.8	(6.9)	17.6	(35.2)	26.1	(52.2)	

(a) F - Mill with ≤BPT flow; B - Mill with ≤BPT BOD5.
(b) No-sulfur pulping.
(c) Production data held confidential.
(d) Ammonia-base.
(e) A reverse osmosis system is used to treat internal process streams and allow for extensive recycle of these treated streams. Not included in averages.
(f) Mill 020011 has combined effluent with other mills. Not included in averages.
(g) Mill 020018 makes recycled paperboard and corrugating. Mill 020016 makes tissue and fine papers. These mills are not considered representative and are not included in averages.

where a BOD5 RWL lower than BPT BOD5 RWL is attained. Application of this methodology yields BCT Option 1 flow and BOD5 RWL of 30.5 kl/kkg (7.3 kgal/t) and 17.6 kg/kkg (35.2 lb/t). The BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [12.3 kg/kkg (24.6 lb/t)].

Unbleached Kraft and Semi-Chemical - Table III-12 presents available RWL data for this subcategory. BCT Option 1 RWLs for this subcategory are the averages of those mills where RWLs lower than BPT RWLs are attained. Application of this methodology yields BCT Option 1 flow and BOD5 RWL of 48.0 kl/kkg (11.5 kgal/t) and 16.3 kg/kkg (32.5 lb/t). The BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [20.5 kg/kkg (41.0 lb/t)].

Dissolving Sulfite Pulp - Table III-13 presents available RWL data for this subcategory. In previous effluent limitations guidelines development, EPA recognized that a variety of products are made at dissolving sulfite pulp mills that result in different waste characteristics. However, the data request program provided only limited RWL data by product types for this subcategory. Consequently, EPA estimated the RWL reductions attainable through the application of specific production process controls.

Several specific production process control modifications are applicable in this subcategory, and these are shown in Table III-1. Each of these controls has been employed at dissolving sulfite pulp mills. In general, most of the items under consideration result in minor flow reductions with the exception of recycle of the hydraulic barking water. Smaller but significant flow reductions can also be obtained from the following modifications: 1) cooling water segregation, 2) more extensive use of white water in the pulp and paper mills, 3) liquor and pulp dryer spill collection, 4) caustic filtrate evaporation, 5) reuse of vacuum pump seal water, and 6) high pressure showers. These controls can reduce wastewater discharge by 41.7 kl/kkg (10.0 kgal/t). Predicted BOD5 reductions resulting from the application of these controls (excluding caustic filtrate evaporation) total 6.4 kg/kkg (12.8 lb/t). Caustic filtrate evaporation results in BOD5 RWL reductions varying from 40.0 kg/kkg (80.0 lb/t) for nitration grade pulp production to 103.0 kg/kkg (206.0 lb/t) for acetate grade pulp production. This technology is an expensive production process control, yet one that can result in significant BOD5 reduction. It has been employed at mills 046002 and 046006.

Another control, neutralization of spent sulfite liquor, is applicable to mills that use MgO as a base and results in significant BOD5 reductions varying from 26.5 kg/kkg (53.0 lb/t) for nitration grade pulp production to 30.5 kg/kkg (61.0 lb/t) for acetate grade pulp production.

The resulting BCT Option 1 BOD5 RWLs are presented below. BOD5 RWLs are presented separately for mills which employ MgO as a

TABLE III-12

SUMMARY RAW WASTE LOAD DATA
UNBLEACHED KRAFT AND SEMI-CHEMICAL SUBCATEGORY

	Production Profile						Raw Waste Load						
	Furnish(%)(a)		Product				Flow		BOD5		TSS		
Mill No.	Semi-Chem	UBK	Corrugating(%)	Board (%)	Bag(%)	Total(t/d)	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	≤BPT(b)
015001(c)	17	86	21	74	5	1,745	58.4	(14.0)	23.6	(47.2)	27.5	(55.0)	F
015002	20	67	24	60	17	(e)	47.2	(11.3)	13.5	(27.0)	13.5	(27.0)	BF
015003	16	85	20	80	0	(e)	50.9	(12.2)	18.8	(37.6)	29.0	(58.0)	BF
015004	16	77	18	70	12	(e)	67.6	(16.2)	17.1	(34.2)	47.0	(94.0)	B
015005(c)	16	84	21	0	79	1,394	30.5	(7.3)	8.8	(17.6)	--	(--)	BF
015006(c)	9	90	12	50	38	2,598	50.5	(12.1)	18.9	(37.8)	9.8	(19.6)	BF
015007(c)	14	76	21	79	0	1,700	52.2	(12.5)	16.3	(32.6)	25.1	(50.2)	BF
015008(c)	18	84	16	84	0	1,133	81.0	(19.4)	19.0	(38.0)	20.7	(41.4)	B
015009(c)(d)	28	65	38	62	0	716	57.6	(13.8)	28.1	(56.2)	29.1	(58.2)	F
010017	13	91	16	58	26	1,428	36.7	(8.8)	17.5	(35.0)	38.3	(76.6)	BF
Average							53.4	(12.8)	18.2	(36.3)	26.7	(53.3)	
BPT Raw Waste Load							58.4	(14.0)	19.4	(38.8)	20.5	(41.0)	
Average of Mills with ≤BPT flow							48.0	(11.5)	18.2	(36.4)	24.6	(49.2)	
Average of Mills with ≤BPT BOD5							52.2	(12.5)	16.3	(32.5)	26.2	(52.4)	

(a) Calculated percentage based on claimed production. Other fibers and/or losses not accounted for.

(b) F - Mill with ≤BPT flow; B - Mill with ≤BPT BOD5.

(c) Market pulp production is included with board production data; production of converting papers is included with bag production.

(d) Data is representative of unbleached kraft and semi-chemical operation. Subsequent to data collection, mill was converted to some bleached kraft processes and is now classified as an integrated miscellaneous mill.

(e) Production data held confidential.

TABLE III-13

SUMMARY RAW WASTE LOAD DATA
DISSOLVING SULFITE PULP SUBCATEGORY

		Raw Waste Load					
		Flow		BOD5		TSS	
Mill No.	Production (t/d)	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
046001(a)	421	228.7	(54.8)	154.1	(308.2)	29.3	(58.6)
046002(b)	560	259.1	(62.1)(c)	--	(--)	--	(--)
046003	620	265.0	(63.5)(c)(d)	114.5	(228.9)	11.2	(22.3)
046004(f)	(e)	190.7	(45.7)	97.2	(194.4)	39.6	(79.2)
046005	(e)	358.5	(85.9)	276.0	(552.0)	--	--
046006(a)	(e)	182.8	(43.8)	99.2	(198.3)	53.6	(107.1)
Average		258.7	(62.0)	161.0	(321.9)	31.3	(62.7)
BPT Raw Waste Loads are dependent on grade of pulp produced and are as follows:							
Nitration		275.0	(66.0)	137.0	(274.0)	92.5	(185.0)
Viscose		275.0	(66.0)	156.0	(312.0)	92.5	(185.0)
Cellophane		275.0	(66.0)	181.5	(363.0)	92.5	(185.0)
Acetate		302.1	(72.4)(g)	266.4	(532.8)(g)	92.5	(185.0)

(a) Data obtained from responses by mill representatives to a 1981 questionnaire.

(b) Total raw waste BOD5 and TSS data are not available.

(c) Flow data obtained from telephone conversations with mill representatives in 1981.

(d) Flow data based on 1981 process flow and corresponding 647 ton/day production rate.

(e) Production data held confidential.

(f) Raw waste loads include wastewater from a dissolving sulfite pulp mill and a paper mill. Therefore, data were not included in the averages.

(g) The BPT BOD5 limitation for acetate grade production has been remanded by the Court of Appeals. EPA has not yet promulgated the BOD5 limitation. The flow and BOD5 shown here are representative of the raw waste load associated with the production of acetate grade dissolving pulp at the time the remanded BPT BOD5 limitation was promulgated in 1977.

TABLE III-13 a

Dissolving Sulfite-Development of Option 1 BOD5 Raw Waste Load

	Nitration kg/kkg (lb/t)	Viscose kg/kkg (lb/t)	Cellophane kg/kkg (lb/t)	Acetate kg/kkg (lb/t)
(Mills that do not employ MgO as a base)				
BPT BOD5 RWL	137.0 (274.0)	156.0 (312.0)	181.5 (363.0)	266.4 (532.8)[1]
Reductions Resulting from Application of Specific Production Process Controls	46.4 (92.8)	63.4 (126.8)	71.9 (143.8)	109.4 (218.8)
Option 1 BOD5 RWL	90.6 (181.2)	92.6 (185.2)	109.6 (219.2)	157.7 (314.0)
	Nitration	Viscose	Cellophane	Acetate
(Mills that employ MgO as a base)				
BPT BOD5 RWL	137.0 (274.0)	156.0 (312.0)	181.5 (363.0)	266.4 (532.8)[1]
Reductions Resulting from Application of Specific Production Process Controls	72.9 (145.8)	90.4 (180.8)	101.4 (202.8)	139.9 (279.8)
Option 1 BOD5 RWL	64.1 (128.2)	65.6 (131.2)	80.1 (160.2)	126.5 (253.0)

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[1] The BPT BOD5 limitation for acetate grade production in the dissolving sulfite pulp subcategory has been remanded by the Court of Appeals. The Agency has not yet promulgated the BOD5 limitation. Therefore, a BOD5 RWL corresponding to BPT effluent limitations has not yet been established. The BOD5 RWL of 266.4 kg/kkg (532.8 lb/t) is representative of the BOD5 RWL associated with the production of acetate grade dissolving sulfite pulp at the same time the remanded BPT BOD5 limitation was promulgated in 1977.

base and for mills which do not employ MgO as a base because lower BOD5 levels can be attained at mills employing MgO through neutralization of spent sulfite liquor. Based on engineering calculations supported by the literature or material balances, EPA believes that the application of the specific production process controls identified above can achieve the required degree of effluent reduction. This is further supported by available data. The controls on which BCT Option 1 are based are installed at mill 046006. As illustrated in Table III-12, when acetate grade pulp is produced at mill 046006, the BCT Option 1 flow and BOD5 RWLs are attained.

The BPT flow is 275.0 kl/kkg (66.0 kgal/t) except for mills where acetate grade pulp is produced where the BPT flow is assumed to be 302.1 kl/kkg (72.4 kgal/t). The flow value of 302.1 kl/kkg (72.4 kgal/t) is representative of the production of acetate grade dissolving sulfite pulp at the time the remanded BPT BOD5 limitation was promulgated in 1977. Flow reduction through implementation of production process controls is 41.7 kl/kkg (10.0 kgal/t). It is the same for all mills since no flow reduction results from neutralization of spent sulfite liquor. This results in BCT Option 1 flow of 233.7 kl/kkg (56.0 kgal/t) for the nitration, viscose, and cellophane pulp grades and 260.4 kl/kkg (62.4 kgal/t) for the acetate pulp grade. The BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [92.5 kg/kkg (185.0 lb/t)].

Papergrade Sulfite [Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) Subcategories] - Table III-14 presents available RWL data for 17 mills characteristic of these subcategories. At mills in these subcategories, a sulfite cooking process is employed to produce pulps from which writing, printing, business, and tissue papers are made. Pulps are produced using calcium, sodium, ammonia, and magnesium cooking bases. The quantity of papergrade sulfite pulp produced at these mills varies from 32 to 100 percent of the total raw material furnish.

Spent liquor recovery systems employed in this subcategory range from no recovery to the use of spent liquor evaporation systems in conjunction with modern kraft-type and fluidized bed recovery furnaces and incinerators. As shown in Table III-14, mills where recovery systems are not employed have significantly higher flow and BOD5 RWLs than mills where recovery is practiced.

BPT effluent limitations were established for two separate papergrade sulfite subcategories (drum wash and blow pit wash) with allowances for mills having acid sulfite cooking and barometric condensers. Available RWL data have been reviewed with respect to the type of washing systems, condensers, and cooking liquors used.

TABLE III-14

SUMMARY RAW WASTE LOAD DATA
PAPERGRADE SULFITE SUBCATEGORY

	Production Profile			Process		
Mill No.	(t/d)	% On-site Sulfite Pulp Produced	Type	Wash (p)	Base (q)	Condenser (r)
040001(b)	(c)	82	Corrug	BP	NH3,BS	U
040002(l)	547	101	Market Tissue	BP	Ca,Na A,BS	Ba,S
040006(e)(f)	131	89	Tissue Market	BP	NH3,A	S
040007(e)(g)	135	100	Market	BP	NH3,A	None
040008(d)	964	78	Tissue Market	BP/DR	NH3,A	Ba,S
040009(d)(m)	566	41	Writing Market	DR	MgO,BS(n)	S
040010(h)(m)	244	32	Glassine Package	BP	Ca,A	S
040011(d)(m)	284	39	Writing Thin	BP	Ca,A	Ba,S
040012(d)(k)(m)	286	72	Writing Printing	DR	NH3,A	Vr
040013(d)(m)	289	65	Printing	DR	MgO,BS(n)	S
040014(d)	146	59	Writing Laminating	BP	Ca,A	S
040015	155	100	Market	BP/DR	Ca,BS	S
040016(d)	437	61	Writing	DR	NH3,A	S
040017(d)	412	42	Printing Market	BP	Ca,A	S
040018(d)	359	34	Tissue	DR	Ca,A	S
040019(i)	(c)	52	Tissue	DR	NH3,A	Vr
040020(d)(m)	671	57	Tissue	DR	NH3,A	Ba
Average		52.7				

TABLE III-14 (Continued)
SUMMARY RAW WASTE LOAD DATA
PAPERGRADE SULFITE SUBCATEGORY
RAW WASTE LOAD

	Flow					BOD 5					TSS	
	Prorated BPT(a)		Long-term Ave.		% Less Than Prorated BPT(o)	Prorated BPT		Long-term Ave.		% Less Than Prorated BPT(o)	Long-term Ave.	
Mill No.	kl/kkg	(kgal/t)	kl/kkg	(kgal/t)		kl/kkg	(kgal/t)	kg/kkg	(kgal/t)		kg/kkg	(lb/t)
040001 (b)	--	.(--)	135.2	(32.4)		--	(--)	68.7	(137.3)		--	(--)
040002 (1)	--	(--)	313.0	(75.0)		--	(--)	84.1	(168.2)		21.0	(42.0)
040006 (e)(f)	--	(--)	346.8	(83.1)		--	(--)	--	(--)		--	(--)
040007 (e)(g)	--	(--)	196.1	(47.0)		--	(--)	421.3	(842.5)		--	(--)
040008 (d)	185.1	(44.35)	186.5	(44.7)		--	(--)	--	(--)		--	(--)
040009 (d)(m)	104.7	(25.09)	83.9	(20.1)	19.9	39.0	(77.97)	48.9	(97.7)		28.6	(57.1)
040010 (h)(m)	92.8	(22.25)	290.9	(69.7)		39.0	(78.04)	27.9	(55.8)	28.5	51.3	(102.5)
040011 (d)(m)	115.8	(27.75)	97.6	(23.4)	15.7	51.9	(103.77)	45.0	(89.9)	13.4	25.9	(51.8)
040012 (d)(k)(m)	147.3	(35.29)	251.2	(60.2)		71.1	(153.35)	54.0	(107.9)	29.6	--	(--)
040013 (d)(m)	137.7	(32.99)	136.5	(32.7)	0.9	57.3	(114.59)	41.4	(82.8)	27.7	31.9	(63.7)
040014 (d)	129.4	(31.01)	170.3	(40.8)		--	(--)	109.4	(218.7)		19.3	(38.6)
040015	--	(--)	--	(--)		--	(--)	--	(--)		--	(--)
040016 (d)	132.2	(31.67)	159.4	(38.2)		--	(--)	109.3	(218.5)		140.2	(280.3)
040017 (d)	106.1	(25.42)	116.4	(27.9)		--	(--)	97.1	(194.2)		37.1	(74.1)
040018 (d)	112.9	(27.06)	131.4	(31.5)		38.4	(76.72)	74.2	(148.4)		65.1	(130.2)
040019 (i)	--	(--)	--	(--)		--	(--)	--	(--)		--	(--)
040020 (d)	150.6	(36.10)	100.6	(24.1)	33.2	61.1	(122.12)	36.3	(72.5)	40.6	11.9	(23.7)
Average					17.4					28.0		
BPT Raw Waste Load												
Blow Pit Wash												
Bisulfite-Surface			186.0	(44.5)				116.0	(232.0)		90.0	(180.0)
Bisulfite-Barometric			221.0	(53.0)				116.0	(232.0)		90.0	(180.0)
Acid Sulfite-Surface			186.0	(44.5)				121.0	(242.0)		90.0	(180.0)
Acid Sulfite-Barometric			221.0	(53.0)				121.0	(242.0)		90.0	(180.0)
Drum Wash												
Bisulfite-Surface			186.0	(44.5)				134.0	(168.0)		90.0	(180.0)
Bisulfite-Barometric			221.0	(53.0)				134.0	(168.0)		90.0	(180.0)
Acid Sulfite-Surface			186.0	(44.5)				103.5	(207.0)		90.0	(180.0)
Acid Sulfite-Barometric			221.0	(53.0)				103.5	(207.0)		90.0	(180.0)

TABLE III-14 (Continued)

(a) Prorated BPT is based on the percents of sulfite pulp and purchased pulp used in early mills furnish. Prorated BPT (for flow/BOD_5/TSS) = (Mill specific BPT for papergrade sulfite) (% sulfite pulp) + (raw waste levels* for NI-fine/tissue papers) (% purchased pulp).
* raw waste levels are a measure of BPT for nonintegrated mills which have no grade change (see text for further details)
(b) Pulp was not bleached at this mill and data are, therefore, not included in averages. Mill is now closed.
(c) Production data held confidential.
(d) Raw waste flows from these mills were used to develop the empirical relation between raw waste flow and percent sulfite pulp produced on-site (see Figure III-1).
(e) Pulp mill operations were shut down shortly after data were gathered. This mill did not employ a recovery system. Data are not included in the averages.
(f) The pulp mill operations were shut down. Operations at this mill are now representative of the Nonintegrated-Tissue Papers subcategory.
(g) Mill is now closed.
(h) This mill produces glassine papers. Flow data are not included in the averages as effluent flow is not considered typical of the subcategory. BOD_5 data for this mill are considered typical of the subcategory and have been included in the averages.
(i) Only a portion of raw waste load was reported. Mill data not included in averages.
(j) The average percent sulfite pulp produced on-site is based on those mills used to develop the empirical relations between flow and percent sulfite pulp (see footnote d) and BOD_5 and percent pulp (see footnote m).
(k) Data are from a 1979 data submittal.
(l) A chemi-mechanical pulp is also made at this mill. Data are not included in the averages.
(m) Raw waste BOD_5 from these mills were used to develop the empirical relation between raw waste BOD_5 and percent sulfite pulp produced on-site (see figure III-2).
(n) This mill does not neutralize spent sulfite liquor and, therefore, has a raw waste BOD_5 load typical of the subcategory.
(o) Percent less than prorated BPT = 100 x (prorated BPT - long-term average)/prorated BPT).
(p) BP - blow pit washing, DR - drum washing (as claimed at time of survey).
(q) A - acid, BS - bisulfite, Ca - calcium, Na - sodium, NH_3 - ammonia, MgO - magnesium oxide.
(r) S - surface, Ba - barometric, U - unknown, Vr - vapor recompression.

The review is discussed in the development document supporting the November 1982 final regulations.(2) No apparent correlations were found between flow and washing processes or between flow and type of condenser used. Also, no apparent correlations were found between BOD5 RWL and washing processes or cooking processes.

Available data indicate that the percent of sulfite pulp (ratio of sulfite pulp manufactured on-site to total paper produced) at a mill is a better predictor of flow and BOD5 RWL than adjustments to the RWL made for any combination of processes used by the mill. Figure III-1 presents the long-term average flow versus percent sulfite pulp manufactured on-site for all mills with flows typical of this subcategory. Data from mill 040001 were omitted because pulp was not bleached at the mill. Mill 040002 data were deleted because a significant amount of chemi-mechanical pulp is manufactured. Data from mills 040006 and 040007 were omitted because no recovery systems are operated and at least some market pulp is manufactured.

Data from mill 040010 were not included because a product is manufactured requiring unusually high quantities of water. Data were not available or were incomplete for mills 040015 and 040019. Mills 040014, 040016, and 040017 have partial recovery systems but are expected to have flows typical of the subcategory; therefore, flow data from these mills have been included in the calculations.

Figure III-2 presents long-term average BOD5 RWL data versus percent sulfite pulp manufactured on-site for mills expected to have typical RWLs. Data from mills 040001, 040002, 040006, 040007, 040015, and 0400019 were omitted for the reasons given above. BOD5 data were not available for mill 040008. Data from mills 040014, 040016, and 040017 were not included because these mills have less than full recovery systems resulting in higher than normal BOD5 RWLs. The BOD5 data point is shown for mill 040018, but was not used in any calculations because it is much greater than BOD5 RWLs for any of the other mills shown and may not be typical of the subcategory. BOD5 data for mill 040010 were included because the mill is expected to have a raw waste BOD5 discharge typical of the subcategory although its flow discharge is not typical.

Included on the flow and BOD5 RWL versus percent sulfite plots are two points representing flow and BOD5 RWL for the manufacture of nonintegrated-fine papers and nonintegrated-tissue papers. These are the expected RWLs for a mill which produces zero percent sulfite pulp on-site. The values shown are average RWLs for nonintegrated-fine papers mills (Table III-23) and nonintegrated-tissue papers mills (Table III-24) with no grade changes. These data are used in the equation development that follows.

The curve shown on the flow plot (Figure III-1) represents an equation developed using a least squares fit method relating flow

FIGURE III-1
RAW WASTE FLOW VS. PERCENT SULFITE PULP ON SITE

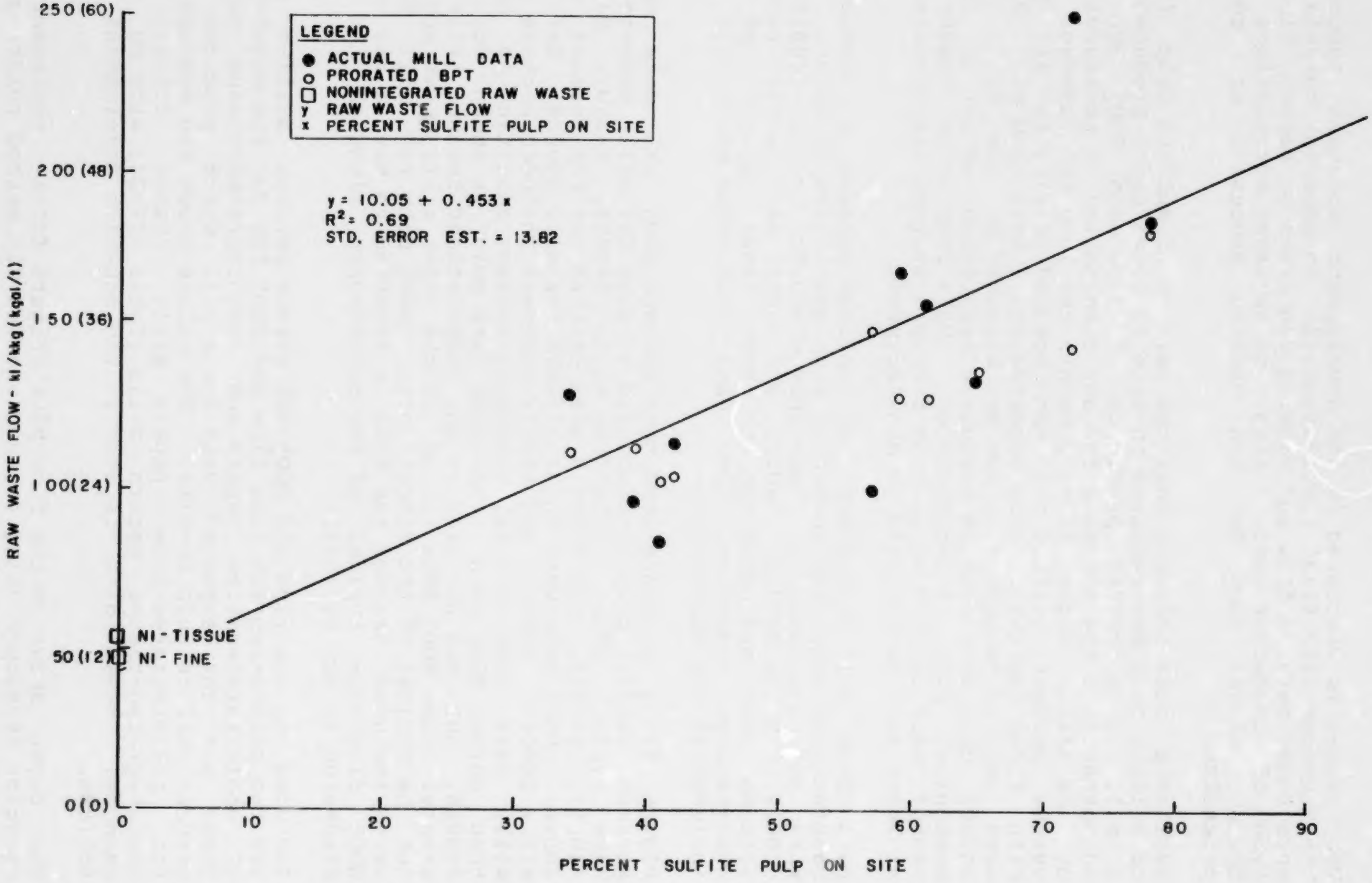
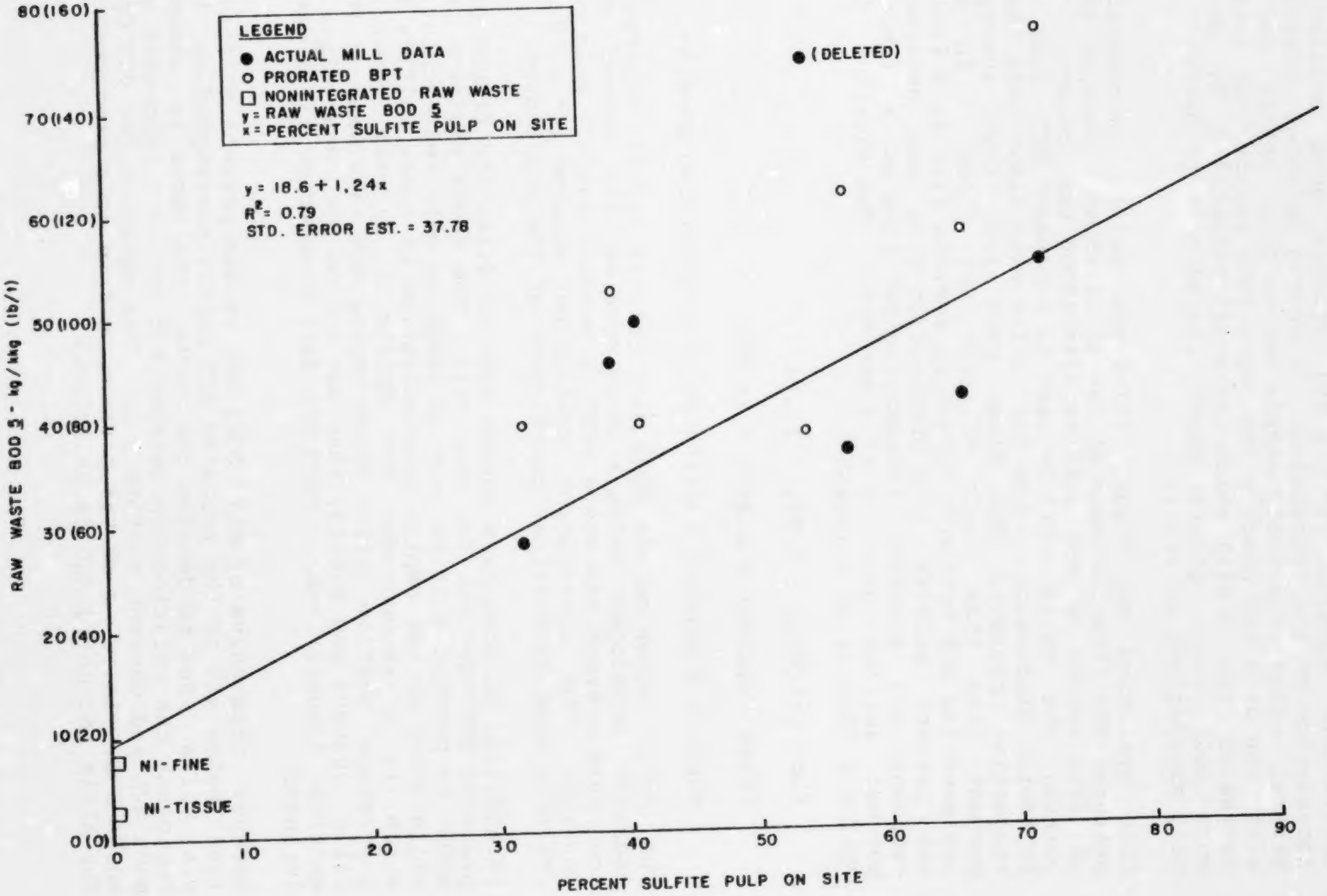


FIGURE III-2
RAW WASTE BOD 5 VS. PERCENT SULFITE PULP ON SITE



to percent sulfite pulp produced on-site. The correlation coefficient squared ($r^2 = 0.69$) reflects good statistical correlation of the regression. It should be noted, however, that several other relatively simple curves show better correlation with the data but predict the impossible result that total flow decreases for a mill which increases production by purchasing more pulp (i.e., greater production with lower percent sulfite pulp manufacture on-site).

Also presented on Figure III-1 are points representing the prorated BPT flow for each of the mills shown. Because the curve of flow versus percent sulfite lies among the prorated BPT flow points, the curve will be used to represent BPT flow in the following discussion. The four mills with flows less than their respective prorated BPT flows have flows that average 17.4 percent less than their prorated BPT flows. An equation representing BCT Option 1 long-term average flow as a function of the percent sulfite pulp produced on-site was determined by reducing the equation representing BPT flow as a function of percent sulfite pulp by 17.4 percent. The equation for BCT Option 1 flow is as follows:

$$\text{flow (kl/kkg)} = 1.89x + 41.94$$

$$[\text{flow (kgal/t)} = 0.453x + 10.05]$$

where x = percent sulfite pulp manufactured on-site.

The curve shown on the BOD_5 plot (Figure III-2) represents an equation developed using a least squares fit method relating long-term average raw waste BOD_5 to percent sulfite pulp produced on-site. The correlation coefficient squared ($r^2 = 0.79$) reflects good statistical correlation of the regression.

In addition to long-term annual average data, the figure presents prorated BPT BOD_5 RWL for each mill. The above equation relating BOD_5 to percent sulfite pulp is based on data representative of mills which do not employ neutralization of spent sulfite liquor, which is a recommended BCT Option 1 process control for papergrade sulfite mills which employ MgO as a base. The two mills (040009 and 040013) that use MgO do not neutralize spent sulfite liquor; thus, BOD_5 RWL data from these mills have been included.

Because this curve of mill BOD_5 RWL versus percent sulfite pulp lies below all of the prorated BPT points corresponding to the six mills used to develop the curve, the curve is assumed to represent the relationship between BCT Option 1 long-term average BOD_5 RWL and percent sulfite pulp. The equation for BCT Option 1 BOD_5 RWL, in terms of the percent sulfite pulp produced on-site for mills not using MgO is as follows:

BOD5 RWL (kg/kkg) = 0.62 x + 9.3

[BOD5 RWL (lb/t) = 1.24 x + 18.6]

where x = percent sulfite pulp manufactured on-site.

The BCT Option 1 BOD5 RWL equation must be modified for mills that use MgO, as neutralization of spent sulfite liquor reduces BOD5 RWL by an estimated 10 kg/kkg (20 lb/t) for mills that manufacture paper from a furnish of only sulfite pulp, 100 percent of which is manufactured on-site. The BOD5 equation for mills using MgO can be found by subtracting 0.10 x kg/kkg (0.20 x lb/t) from the above equations to obtain:

BOD5 RWL (kg/kkg) = 0.52 x + 9.3

[BOD5 RWL (lb/t) = 1.04 x + 18.6]

where x = percent sulfite pulp manufactured on-site.

Neutralization of spent sulfite liquor does not reduce flow, and no adjustment to the flow equation is necessary.

The BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [90.0 kg/kkg (180.0 lb/t)] for a mill that manufactures paper from a furnish of only sulfite pulp. TSS RWL for mills with less than 100 percent sulfite pulp must be calculated by prorating with the BPT TSS for the nonintegrated-fine or tissue paper subcategories, as appropriate.

Groundwood-Thermo-Mechanical - Table III-15 presents available RWL data for this subcategory. Sufficient data are not available to establish BCT guidelines.

Groundwood-CMN Papers - Table III-16 presents available RWL data for mills in this subcategory. No mills in this subcategory attain BOD5 RWLs that are lower than the BPT RWLs. Because the existing performance is inadequate and does not achieve the pollution reduction that is possible at mills in this subcategory, the BCT Option 1 RWLs were calculated by subtracting the predicted RWL reductions resulting from implementation of applicable production process controls from the BPT RWLs.

The production process controls capable of attaining RWL reductions are: 1) segregation of cooling water in the woodroom, 2) addition of pulp mill and paper mill spill collection systems, 3) use of white water in vacuum pumps, 4) recycle of press effluent and vacuum pump seal water, and 5) addition of centralized storage capacity for white water reuse. The total projected flow and BOD5 RWL reductions are 29.2 kl/kkg (7.0 kgal/t) and 4.1 kg/kkg (8.2 lbs/t), respectively. Because each of these production process controls has been employed at

TABLE III-15

SUMMARY RAW WASTE LOAD DATA
GROUNDWOOD-THERMO-MECHANICAL SUBCATEGORY

	Production Profile				Raw Waste Load					
	Pulp (%)		Product		Flow		BOD5		TSS	
Mill No.	TMP	Other GWD	(t/d)	Type	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
070001	90	0	155	Coarse, Uncoated Printing	81.4	(19.5)	19.0	(38.0)	41.3	(82.5)
070002(a)	88	12	497	Newsprint	33.4	(8.0)	16.2	(32.3)	43.4	(86.7)
040003(b)	--	--	--	Newsprint	--	(--)	28.5	(57.0)	--	(--)
Average					57.6	(13.8)	21.1	(42.4)	42.3	(84.6)
BPT Raw Waste Load					88.0	(21.1)	39.2	(78.4)	39.9	(79.8)

(a) Supplemental data submitted by mill for 3/79 - 7/79.
(b) Data are representative of groundwood-thermo-mechanical operation; because other pulping operations are employed, mill is currently classified as integrated miscellaneous.

TABLE III-16

SUMMARY RAW WASTE LOAD DATA
GROUNDWOOD-CMN PAPERS SUBCATEGORY

	Production Profile				Raw Waste Load					
	GWD Furnish		Product		Flow		BOD5		TSS	
Mill No.	%	(t/d)	(t/d)	Type	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
052015	78.7	74	94	Newsprint, Fine	99.7	(23.9)	--	(--)	--	(--)
052016	79.2	369	465	Newsprint	46.7	(11.2)	20.0	(40.0)	--	(--)
054004(a)	61.5	39	64	Molded	94.3	(22.6)	27.0	(53.9)	103.6	(207.2)
054006	72.4	(b)	(b)	Molded	109.3	(26.2)	19.1	(38.2)	56.4	(112.7)
054010(a)	72.7	8	11	Molded	121.9	(29.2)	--	(--)	--	(--)
054015	70.5	693	983	Newsprint, Specialties	118.9	(28.5)	21.4	(42.7)	47.3	(94.5)
Average	72.5				98.5	(23.6)	21.9	(43.7)	69.1	(138.1)
BPT Raw Waste Load					99.3	(23.8)	17.4	(34.8)	48.5	(97.0)

(a) Mill is now closed.
(b) Production data held confidential.

groundwood-CMN mills, groundwood mills in other subcategories, or mills in other subcategories where similar pulp or papermaking processes are employed, EPA believes that these technologies can be applied at mills in the groundwood-CMN papers subcategory. Based on engineering calculations supported by literature or material balances, the Agency believes that the application of these production process controls can achieve the required degree of effluent reduction. The resulting BCT Option 1 flow and BOD$_5$ RWLs are presented below:

Groundwood-CMN Papers--Development of Option 1 Raw Waste Loads

	Flow	BOD$_5$
	kl/kkg (kgal/t)	kg/kkg (lb/t)
BPT RWL	99.3 (23.8)	17.4 (34.8)
Reductions Resulting From Implementation of Specific Production Process Controls	29.2 (7.0)	4.1 (8.2)
Option 1 RWL	70.1 (16.8)	13.3 (26.6)

The BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [48.5 kg/kkg (97.0 lb/ton)].

Groundwood-Fine Papers - Available RWL data for this subcategory are presented in Table III-17. BCT Option 1 RWLs for this subcategory are based on averages of those mills where RWLs that are lower than BPT RWLs are attained.

Application of this methodology yields BCT Option 1 flow and BOD$_5$ RWL of 64.3 kl/kkg (15.4 kgal/t) and 12.5 kg/kkg (24.9 lb/t). The BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [52.5 kg/kkg (105.0 lb/t)].

Deink - Flow, BOD$_5$, and TSS RWL data are available for 20 mills representative of this subcategory and are shown in Table III-18. As discussed in the development document supporting the November 1982 final regulations, differences in flow and BOD$_5$ RWLs justified the division of the deink subcategory into three sectors: fine papers, tissue papers, and newsprint.(2) BCT Option 1 RWLs were developed for the fine papers and tissue papers product sectors. Most mills in the fine papers and tissue papers sectors use some purchased pulp with deinked furnish. Because BPT flow and BOD$_5$ RWL were developed for mills producing a product made entirely from pulp deinked on-site, BPT final effluent levels for individual mills were prorated between final effluent levels for the deink subcategory and the nonintegrated-fine papers or nonintegrated-tissue papers subcategories as appropriate. Therefore, BCT Option 1 flow and BOD$_5$ RWL were also developed for 100 percent deink mills.

TABLE III-17

SUMMARY RAW WASTE LOAD DATA
GROUNDWOOD-FINE PAPERS SUBCATEGORY

	Production Profile			Raw Waste Load						
	GWD Pulp	Product		Flow		BOD5		TSS		≤BPT
Mill No.	(%)	(t/d)	Type	kl/kkg	(kgal/t)	k /kkg	(lb/t)	kg/kkg	(lb/t)	(b)
052003	51.0	535	Printing	88.1	(21.1)	12.2	(24.3)	61.0	(122.0)	BF
052004	31.0	481	Coated	65.9	(15.8)	28.6	(57.2)	79.2	(158.4)	F
052005	39.1	755	Printing	55.5	(13.3)	27.8	(55.6)	56.7	(113.3)	F
052007	58.0	224	Printing	96.8	(23.2)	--	(--)	--	(--)	
052008	41.8	787	Coated	54.7	(13.1)	10.1	(20.1)	56.0	(112.0)	BF
052013	38.5	(a)	Coated	70.1	(16.8)	15.6	(31.2)	41.4	(82.7)	BF
052014	34.0	285	Coated	54.7	(13.1)	12.0	(24.0)	36.9	(73.7)	BF
054014	82.5	76	Printing Specialties	61.3	(14.7)	16.8	(33.6)	46.6	(93.2)	F
Average	47.0			68.4	(16.4)	17.6	(35.1)	54.0	(107.9)	
BPT Raw Waste Load				91.0	(21.9)	16.7	(33.3)	52.5	(105.0)	
Average of Mills with ≤BPT flow				64.3	(15.4)	17.6	(35.1)	54.0	(107.9)	
Average of Mills with ≤BPT BOD5				66.8	(16.0)	12.5	(24.9)	48.8	(97.6)	

(a) Production data held confidential.
(b) F-Mill with ≤BPT flow; B-Mill with ≤BPT BOD5.

TABLE III-18

SUMMARY RAW WASTE LOAD DATA
DEINK SUBCATEGORY

	Production Profile						
	Furnish (t/d)						
		Deink		Purch (t/d)		Product	
Mill No.	(t/d)(a)	%(b)	WP(c)	Pulp	Broke	(t/d)	Type
Deink Fine							
140005(1)	188	50	--	166	19	379	Unctd Print Writing
140007(2)	(d)	52	(d)	(d)	(d)	(d)	Ctd & Unctd Printing
140008(1)	77	62	9	10	29	128	Unctd Print Writing
140017(1)	(d)	62	(d)	(d)	(d)	(d)	Ctd Print
140019(2)	(d)	67.4	(d)	(d)	(d)	(d)	Unctd Print
Deink Tissue							
140010(1)	(d)	50	(d)	(d)	(d)	(d)	San Tissue
140029(e)(1)	20	73	--	6	--	22	San Tissue
140030(3)	--	76.7	30	30	--	270	San Tissue
140011(1)	(d)	96	(d)	(d)	(d)	(d)	San Tissue
140014(4)	(d)	94	(d)	(d)	(d)	(d)	San Tissue
140015(4)	(d)	100	(d)	(d)	(d)	(d)	Tissue
140018(f)(1)	36	97	--	--	1	36	Ind Wrap,Tissue
140021(i)(5)	170	100	--	--	--	173	San Tissue
140022(6)	--	53	--	35	--	75	San Tissue
140024(1)	(d)	100	(d)	(d)	(d)	(d)	San Tissue
140025(1)	92	85	--	4	11	100	San Tissue
140028(j)(1)	(d)	99	(d)	(d)	(d)	(d)	San Tissue

TABLE III-18 (cont.)

SUMMARY RAW WASTE LOAD DATA
DEINK SUBCATEGORY

Mill No.	FLOW: Annual Average Before Recycle: Prorated BPT kl/kkg	(kgal/t)	Long-term Annual Ave. kl/kkg	(kgal/t)	%Better than BPT (A)	After Recycle: Long-term Annual Ave kl/kkg	(kgal/t)	Recycle % (B)	BOD5: Annual Average Long-term Annual Ave. kg/kkg	(lb/t)	Adjusted to 100% deinked Pulp (C) kg/kkg	(lb/t)	Influent Primary Conc. mg/t	Influent Secondary Conc. mg/l	% Reduction through Primary (D)	Annual Ave TSS kg/kkg	(lb/t)
Deink Fine																	
140005	82.6	(19.8)	100.1	(24.0)					--	(--)	--	(--)				197.3	(394.6)
140007	83.5	(20.0)	63.0	(15.1)	24.5	44.6	(10.7)	29.1	62.8	(125.5)	110.6	(221.2)	997	761	23.7	159.4	(318.7)
140008	87.2	(20.9)	114.8	(27.5)					72.6	(145.3)	110.5	(221.0)	634	405	36.1	189.0	(377.9)
140017	87.2	(20.9)	126.4	(30.3)					20.4	(40.8)	26.2	(52.4)				216.0	(432.0)
140019	89.3	(21.4)	34.7	(8.3)	61.2	27.8	(6.65)	19.3	22.5	(44.9)	28.2	(56.3)	648	403	37.8	130.0	(260.1)
Average					42.9%			24.2%			68.9	(137.7)			32.5		
Deink Tissue																	
140010	98.9	(23.7)	121.0	(29.0)					63.0	(126.0)	115.6	(231.2)				133.9	(267.7)
140029(e)	--	(--)	--	(--)					--	(--)	--	(--)				--	(--)
140030(f)	100.6	(24.1)	72.2	(17.3)	28.2	26.7	(6.4)	63.0	71.5	(143.0)	89.8	(179.5)				169.1	(338.2)
140011	101.4	(24.3)	90.6	(21.7)	10.7				104.2	(208.5)	108.2	(216.3)				292.1	(584.2)
140014	101.4	(24.3)	98.1	(23.5)	3.3				89.8	(179.7)	94.9	(189.8)				218.6	(437.3)
140015	101.8	(24.4)	100.6	(24.1)	1.2				56.1	102.1	51.0	(102.1)				22.4	(44.7)
140018(g)	101.8	(24.4)	46.3	(11.1)		25.5	(6.1)	45.0	--	(--)	--	(--)				--	(--)
140021(k)	101.8	(24.4)	190.3	(45.6)		84.3	(20.2)	55.7	142.2	(284.3)	142.2	(284.3)	747	286	61.7	368.5	(737.0)
140022	98.9	(23.7)	94.7	(22.7)	4.2	78.0	(18.7)	17.6	37.2	(74.4)	61.0	(121.9)				125.4	(250.8)
140024	101.8	(24.4)	203.2	(48.7)					148.3	(296.5)	148.2	(296.5)				320.8	(641.6)
140025	101.0	(24.2)	62.6	(15.0)	38.0				36.0	(71.9)	40.4	(80.9)	575	260	54.8	161.6	(323.2)
140028	--	(--)	156.1	(37.4)					112.6	(225.1)	--	(--)				375.2	(750.3)
Average					14.3%			40.3%			94.6	(189.2)			58.3		
Average of Deink-Fine and Tissue Papers Mills															42.8		
Deink Newsprint																	
140002(h)																	
140003(h)																	
140013(h)																	
Average			67.6	16.2					15.9	31.7							

TABLE III-18 (cont.)

SUMMARY RAW WASTE LOAD DATA
DEINK SUBCATEGORY

Notes:

(a) Wastepaper to deink process.
(b) Percentage of deink pulp is the ratio of deinked pulp to total pulp used.
(c) Wastepaper.
(d) Production data held confidential.
(e) Self-contained; not included in averages.
(f) Produces a coarse grade and recirculates approximately 50% of its treated effluent. Not included in averages.
(h) Production and raw waste load data held confidential.
(i) Flow at this mill > BPT flow. Not included in recycle averages.
(j) Mill produces 46% market pulp. Not included in averages.

Data Source: (1) 1977 Data Request Program; (2) Supplemental Data Acquisition Program; (3) Discharge Monitoring Report data 1981-2; (4) Verification Program; (5) Long-term Sampling Program; (6) Discharge Monitoring Report Data 1983.

(A) % better than BPT = 100 x (BPT - LTAA)/BPT.
(B) % recycle = 100 x (flow before recycle - flow after recycle)/flow before recycle.
(C) Adjusted BOD$_5$ =
[LTAA BOD$_5$ - (% p.p./100)(BOD$_5$ due to p.p.)]/(% deinked pulp/100)

where p.p. = purchased pulp
% p.p. = 100 - % deinked pulp
LTAA BOD$_5$ = long-term annual average BOD$_5$
BOD$_5$ due to p.p. = raw waste BOD$_5$ contributed by purchased pulp
i.e., raw waste loads for nonintegrated-fine or tissue papers. See text for further explanation.

(D) % reduction through primary = 100 x (primary influent conc. - primary effluent conc.)/(primary influent conc.).

The methodology, discussed above, was used to develop BCT Option 1 flow for both the deink-fine papers and deink-tissue papers sectors. Prorated BPT flow, based on the percent of deinked furnish used, was determined for each mill. The two deink-fine paper mills and the six deink-tissue paper mills with flows less than their respective prorated BPT flows have flows that average 42.9 and 14.3 percent less than their prorated BPT flows, respectively. Data from mill 140018 was not included in the average because it produces a coarse grade of pulp atypical of other mills in the subcategory; data from mill 140028 was not included because it produces 46 percent market pulp. BCT Option 1 flows for the fine papers and tissue papers sectors were found by decreasing BPT flow (the same for both sectors) by 42.9 percent and 14.3 percent, respectively, to obtain 58.0 kl/kkg (13.9 kgal/t) for deink-fine papers and 87.2 kl/kkg (20.9 kgal/t) for deink-tissue papers.

Because recycle of primary effluent is a recommended BCT Option 1 control, it was also necessary to determine BCT Option 1 flow after recycle for both sectors. Mills that recycle primary effluent were identified and the percent of the effluent recycled to process was determined for each mill as follows:

$$\text{percent recycle} = 100\ \frac{(\text{raw waste flow} - \text{flow to secondary treatment})}{\text{raw waste flow}}$$

Data from mill 140018 was not included in the average because it produces a coarse grade of pulp; data from mill 140021 was not included because its flow before recycle is greater than the prorated BPT flow for this mill.

The average flow recycled for each sector (based only on mills that recycle) was 24.2 percent for deink-fine papers and 40.3 percent for deink-tissue papers. The average percent flow was then subtracted from BCT Option 1 raw waste flows for each sector to find the BCT Option 1 biological treatment influent (and effluent), as follows:

$$\underset{\text{(after recycle)}}{\text{BCT Option 1 flow}} = \underset{\text{(raw waste)}}{\text{BCT Option 1 flow}} \times \left(1 - \frac{\text{percent recycled}}{100}\right)$$

The final effluent BCT Option 1 flows were found to be 44.2 kl/kkg (10.6 kgal/t) for deink-fine papers and 52.2 kl/kkg (12.5 kgal/t) or deink-tissue papers.

When the BPT BOD$_5$ RWL was developed, EPA concluded that there was no difference between BOD$_5$ RWLs for the fine papers and tissue papers sectors of the deink subcategory. A review of the currently available data suggests that the BOD$_5$ RWL for the deink-fine papers sector is substantially lower than that for the deink-tissue papers sector. Since prorated BPT BOD$_5$ was considered an inaccurate measure of performance for BOD$_5$ RWL for this subcategory, another method was used to determine the average BOD5 RWL of mills which deink 100 percent of their furnish.

The method used is described in detail on pages 233-238 in the December 1976 development document supporting the Phase II promulgated BPT regulations.(9) Actual BOD5 RWLs for each mill were adjusted to equal the values that would be estimated for the mill if it did not purchase pulp but deinked 100 percent of its furnish. EPA adjusted the BOD5 RWLs by subtracting the estimated contribution by purchased pulp to the BOD5 RWLs. This can be expressed as follows:

Adjusted BOD5 RWL = [BOD5 RWL - (1-p) x (BOD5 PP)]/p

where BOD5 RWL = Actual mill BOD5 RWL,

p = the fraction of deinked pulp in the furnish

(i.e. percent/100),

(BOD5 PP) = BOD5 due to purchased pulp, and

(1-p) = the fraction of purchased pulp in the furnish.

The estimated contribution to the BOD5 RWL by purchased pulp was based on average BOD5 RWL for the nonintegrated-fine or tissue papers subcategory (as appropriate) without regard to significant grade changes. These averages, presented in Table III-22 and Table III-23 are 10.9 kg/kkg (21.8 lb/t) for nonintegrated-fine papers and 10.4 kg/kkg (20.8 lb/t) for nonintegrated-tissue papers.

The BCT Option 1 BOD5 RWL for each sector was then found by averaging the adjusted BOD5 loads for all mills in the sector. The average of all mills in each sector is assumed to be BCT Option 1 because the data are representative of the period of time since the implementation of BPT effluent guidelines; therefore, the mills' performance reflects the implementation of BPT production process controls. BCT Option 1 BOD5 RWL was found to be 68.9 kg/kkg (137.7 lb/t) for deink-fine papers and 94.6 kg/kkg (189.2 lb/t) for deink-tissue papers.

Sufficient data are available to indicate that the BOD5 reduction by primary clarification is substantial for mills in this subcategory. Primary influent, and biological treatment system influent (primary effluent) BOD5 concentrations are presented for five deink mills in Table III-17 with the percent BOD5 reduction by primary clarification for each mill. The average percent reduction for all five mills was found to be 42.8 percent. It was assumed that this average reduction can be attained by means of chemically assisted clarification (CAC). The average is conservative as only three of the five mills actually employ CAC.

The biological treatment influent BOD5 load was determined by reducing the raw waste (primary influent) BOD5 by 42.8 percent. Thus, the biological treatment influent BOD5 is 39.4 kg/kkg (78.8 lb/t) for deink-fine papers and 54.1 kg/kkg (10.8 lb/t) for the deink-tissue papers sectors.

For both the fine papers and tissue papers sector, the BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [202.5 kg/kkg (405 lb/t)].

Sufficient data are not available to establish BCT guidelines for the newsprint sector of the deink subcategory.

Tissue From Wastepaper - In the tissue from wastepaper subcategory, extensive use of production process controls to reduce wastewater discharge is practiced. As seen in Table III-19, RWL data were reviewed considering the production of industrial and sanitary tissue. No significant differences were found between the two product sectors.

BCT Option 1 RWLs for this subcategory are based on averages of those mills where RWLs that are lower than BPT RWLs are attained. Mills 090006, 100012, 105007, and 100014 are excluded from BCT Option 1 RWL averages because extensive wastewater recycle is used and flows are significantly lower than for other mills. Application of this methodology yields BCT Option 1 flow and BOD5 RWL of 68.0 kl/kkg (16.3 kgal/t) and 9.7 kg/kkg (19.3 lb/t). The BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [110.5 kg/kkg (221.0 lb/t)].

Paperboard From Wastepaper - Available RWL data for mills in this subcategory are presented in Table III-20. As discussed in the development document supporting the November 1982 promulgated regulations, EPA determined that the BOD5 RWL is substantially higher when recycled corrugating medium is processed than when other types of wastepaper are processed, but no such correlation exists between wastewater flow and the type of furnish used.(2) Therefore, two sectors were identified to account for BOD5 RWL differences that result from the type of furnish used. BCT Option 1 flows for both sectors are based on the average of those mills where flows are lower than BPT flow. Application of this methodology yields BCT Option 1 flow of 13.4 kl/kkg (3.2 kgal/t). BCT Option 1 BOD5 RWLs for the corrugating medium furnish and noncorrugating medium furnish sectors are the same as the BPT RWLs, 23.0 kg/kkg (46.0 lb/t) and 11.3 kg/kkg (22.5 lb/t). The BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [11.0 kg/kkg (21.9 lb/t)].

Wastepaper-Molded Products - Available RWL data for mills in this subcategory are presented in Table III-21. Extensive recycle of effluent is practiced at several mills. BCT Option 1 RWLs are based on averages for those mills where extensive recycle is practiced. Application of this methodology yields Option 1 flow and BOD5 RWL of 23.8 kl/kkg (5.7 kgal/t) and 5.5 kg/kkg (10.9 lb/t). The BCT Option 1 TSS RWL is assumed to be the same as the

TABLE III-19

SUMMARY RAW WASTE LOAD DATA
TISSUE FROM WASTEPAPER SUBCATEGORY

	Production	Raw Waste Load						
		Flow		BOD5		TSS		
Mill No.	(t/d)	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	≤BPT(b)
I. Industrial Tissue								
090002	19.5	72.6	(17.4)	--	(--)	--	(--)	F
085004	47.0	141.9	(34.0)	22.4	(44.7)	106.4	(212.8)	
085006	(a)	138.1	(33.1)	37.6	(75.1)	103.3	(206.5)	
090006(c)	10.5	29.2	(7.0)	--	(--)	46.7	(93.3)	
100005	15.2	62.2	(14.9)	14.2	(28.4)	38.0	(76.0)	BF
100011	11.2			Self-contained				
100012(c)	7.0	35.5	(8.5)	--	(--)	--	(--)	
100015	5.5			Self-contained				
100001	(a)	84.7	(20.3)	6.5	(13.0)	13.3	(26.5)	BF
Average w/o Self-Contained Mills		99.7	(23.9)	20.2	(40.3)	65.3	(130.5)	
II. Sanitary Tissue								
090004	20.0	59.7	(14.3)	--	(--)	--	(--)	F
090010	(a)	76.8	(18.4)	18.8	(37.6)	59.4	(118.7)	F
100002	7.5			Self-contained				
100003	83.0	51.7	(12.4)	8.7	(17.3)	9.2	(18.4)	BF
100004	15.0			Self-contained				
100007(d)	20.0			Self-contained				
100008	16.0			Self-contained				
100013	20.0	156.5	(37.5)	9.3	(18.6)	88.9	(177.8)	B
100016	7.3	237.9	(57.0)	53.5	(107.0)	128.0	(255.9)	
105007(c)	11.9	22.1	(5.3)	--	(--)	--	(--)	
090014	40.7	138.5	(33.2)	22.0	(44.0)	68.2	(136.3)	
100014(c)(d)	20.7	9.2	(2.2)	--	(--)	--	(--)	
Average w/o Self-Contained Mills		120.2	(28.8)	22.5	(44.9)	70.7	(141.4)	
Overall Average w/o Self-Contained Mills		111.0	(26.6)	21.5	(42.9)	68.3	(136.5)	
BPT Raw Waste Load		105.0	(25.2)	14.5	(29.0)	110.5	(221.0)	
Average of All Mills with ≤BPT flow		68.0	(16.3)	12.1	(24.1)	30.0	(59.9)	
Average of All Mills with ≤BPT BOD5		88.9	(21.3)	9.7	(19.3)	37.4	(74.7)	

(a) Production data held confidential.
(b) F-Mill with ≤BPT flow; B-Mill with ≤BPT BOD5.
(c) Extensive wastewater recycle performed; not included in averages.
(d) Mill is now closed.

TABLE III-20

SUMMARY RAW WASTE LOAD DATA
PAPERBOARD FROM WASTEPAPER SUBCATEGORY

Mill No.	Production Profile (t/d) (a)								Percent Corrugated Furnish	Raw Waste Load						
										Flow		BOD5		TSS		
	A	B	C	D	E	F	G	Total		kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	≤BPT(b)
Noncorrugating Medium Furnish																
085002	-	-	-	-	-	-	35	35	56	--------------------Self-Contained----------------------						
085009	-	-	-	-	-	-	90	90	6	37.1	(8.9)	8.9	(17.7)	12.6	(25.2)	B
110001(e)	300	250	240	170	-	-	-	960	59	28.4	(6.8)	12.5	(25.0)	19.3	(38.5)	F
110002	-	-	45	-	-	-	-	45	33	0.4	(0.1)	2.0	(3.9)	10.8	(21.5)	FB
110003(e)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	19	20.9	(5.0)	--	(--)	--	(--)	F
110004	-	-	-	-	178	-	-	178	10	15.9	(3.8)	13.0	(25.9)	12.1	(24.2)	F
110005	-	-	16	130	16	-	-	162	46	--	(--)	--	(--)	--	(--)	
110006	-	-	-	127	-	-	-	127	24	10.0	(2.4)	32.3	(64.6)	23.6	(47.2)	F
110007	-	-	-	170	-	-	-	170	18	--------------------Self-Contained----------------------						
110008	-	-	-	58	14	-	-	72	45	16.3	(3.9)	20.3	(40.6)	6.4	(12.8)	F
110009	-	-	94	-	-	-	-	94	7	23.4	(5.6)	3.6	(7.1)	8.2	(16.3)	FB
110011	-	-	14	35	-	-	122	171	40	17.9	(4.3)	7.3	(14.6)	11.1	(22.2)	FB
110012	-	-	-	208	-	-	-	208	18	15.9	(3.8)	4.5	(9.0)	10.3	(20.6)	FB
110013	-	-	(410 C+D)		-	-	-	410	22	25.5	(6.1)	12.5	(25.0)	35.9	(71.7)	F
110015	-	-	-	-	-	-	79	79	0	--------------------Self-Contained----------------------						
110016	-	-	-	-	-	-	49	49	0	--------------------Self-Contained----------------------						
110017	-	-	-	-	-	-	84	84	0	2.5	(0.6)	--	(--)	--	(--)	F
110018	------------no data given------------------------								49	--------------------Self-Contained----------------------						
110019	-	-	-	18	25	-	36	79	20	--	(--)	--	(--)	--	(--)	
110020	-	-	-	9	23	-	54	86	17	--	(--)	--	(--)	--	(--)	
110022	-	-	-	23	-	-	17	40	28	76.4	(18.3)	14.1	(28.2)	29.8	(59.6)	
110023	-	138	-	-	-	-	-	138	56	--	(--)	--	(--)	--	(--)	
110024	-	223	90	-	-	-	24	337	71	4.2	(1.0)	3.2	(6.3)	2.3	(4.5)	FB
110026	-	-	-	-	-	-	150	150	0	--------------------Self-Contained----------------------						
110029	-	-	2	-	-	133	-	135	63	9.6	(2.3)	7.5	(14.9)	8.8	(17.5)	FB
110031	-	-	-	-	-	150	-	150	44	7.1	(1.7)	--	(--)	--	(--)	F
110032	-	-	-	74	-	-	-	74	61	--	(--)	--	(--)	--	(--)	
110033	96	-	-	-	-	-	-	96	82	--------------------Self-Contained----------------------						
110034	-	-	-	-	-	165	-	165	31	--	(--)	--	(--)	--	(--)	
110035	-	-	-	150	27	-	44	221	5	18.8	(4.5)	13.0	(26.0)	10.7	(21.4)	F
110036	-	-	-	61	-	-	-	61	9	8.3	(2.0)	3.7	(7.3)	1.3	(2.6)	FB
110037	-	-	-	89	57	-	20	166	28	--------------------Self-Contained----------------------						
110038	-	-	-	92	-	-	3	95	16	40.9	(9.8)	12.5	(24.9)	13.9	(27.8)	
110039	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	18	31.3	(7.5)	15.4	(30.8)	27.2	(54.3)	
110040	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	16	25.0	(6.0)	9.7	(19.4)	7.9	(15.7)	FB
110041	88	-	16	-	-	-	-	104	35	35.9	(8.6)	5.2	(10.4)	4.1	(8.1)	B
110043	-	-	130	30	-	-	-	160	46	18.8	(4.5)	1.0	(1.9)	1.1	(2.2)	FB
110044	-	-	108	-	-	-	-	-	39	--------------------Self-Contained----------------------						
110045	-	-	100	175	25	-	-	300	34	30.0	(7.2)	1.0	(2.0)	39.3	(78.5)	FB
110046	-	-	-	-	-	-	-	36	67	37.1	(8.9)	--	(--)	7.1	(14.2)	

TABLE III-20 (Continued)

Mill No.	Production Profile (t/d) (a) A	B	C	D	E	F	G	Total	Percent Corrugated Furnish	Raw Waste Load Flow kl/kkg	Flow (kgal/t)	BOD5 kg/kkg	BOD5 (lb/t)	TSS kg/kkg	TSS (lb/t)	≤BPT(b)
110047	-	-	100	70	100	-	-	270	23	20.0	(4.8)	6.5	(13.0)	2.1	(4.1)	FB
110048	-	-	-	-	-	-	53	53	8	--	(--)	--	(--)	--	(--)	
110050	-	-	32	234	-	-	5	271	24	30.5	(7.3)	10.0	(20.0)	11.0	(21.9)	B
110051	-	-	40	146	-	-	9	195	33	45.5	(10.9)	10.7	(21.4)	13.1	(26.2)	B
110052	-	-	-	-	-	95	-	95	26	25.5	(6.1)	9.1	(18.1)	5.0	(10.0)	FB
110053	-	-	-	300	-	-	-	300	34	12.9	(3.1)	8.1	(16.2)	2.8	(5.5)	FB
110055	(153		A+B+C)	-	-	-	-	153	99	14.6	(3.5)	16.4	(32.7)	11.8	(23.5)	F
110056	10	-	-	-	55	-	-	65	47	21.7	(5.2)	9.2	(18.4)	7.1	(14.1)	FB
110058	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	44	14.2	(3.4)	10.0	(19.9)	11.9	(23.8)	FB
110059	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	56	42.1	(10.1)	16.5	(32.9)	26.2	(52.3)	
110060	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	1	--	(--)	--	(--)	--	(--)	
110061	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	32	31.3	(7.5)	9.1	(18.1)	8.6	(17.2)	B
110062	-	-	-	89	3	-	4	96	26	34.6	(8.3)	11.5	(22.9)	8.2	(16.4)	
110064	-	-	-	-	-	-	11	11	23	------Self-Contained------						
110065	-	-	-	-	-	76	-	76	--	--	(--)	--	(--)	--	(--)	
110066	-	-	-	-	120	-	-	120	20	5.4	(1.3)	7.7	(15.3)	9.8	(19.6)	FB
110067	-	-	-	-	-	-	58	58	23	28.8	(6.9)	1.5	(3.0)	1.5	(3.0)	FB
110068	-	-	-	-	-	-	437	437	49	7.5	(1.8)	6.5	(12.9)	--	(--)	FB
110069	-	-	-	134	-	-	-	134	34	30.9	(7.4)	7.4	(14.8)	16.5	(33.0)	B
110070	-	-	-	68	-	-	-	68	47	4.2	(1.0)	--	(--)	--	(--)	F
110071	-	-	-	-	-	-	58	58	61	--	(--)	--	(--)	--	(--)	
110072	-	-	-	-	-	-	152	152	0	34.6	(8.3)	10.4	(20.8)	26.6	(53.2)	B
110074	-	-	-	-	-	-	63	63	69	--	(--)	--	(--)	--	(--)	
110075	-	-	-	-	-	-	68	68	66	8.3	(2.0)	--	(--)	--	(--)	F
110076	-	-	-	-	-	-	99	99	54	4.2	(1.0)	5.1	(10.2)	2.5	(4.9)	FB
110077	-	-	-	-	-	-	175	175	81	--	(--)	--	(--)	--	(--)	
110078	-	-	-	-	-	-	63	63	75	2.5	(0.6)	--	(--)	--	(--)	
110079	-	-	-	-	-	-	61	61	81	11.3	(2.7)	--	(--)	6.9	(13.7)	F
110081	-	-	60	-	-	-	-	60	--	------Self-Contained------						
110082	-	-	45	40	30	-	-	115	19	79.7	(19.1)	5.2	(10.4)	3.5	(6.9)	B
110083	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	65	28.0	(6.7)	8.9	(17.8)	10.8	(21.5)	FB
110084	-	-	-	-	-	105	-	105	11	15.9	(3.8)	3.2	(6.4)	4.6	(9.1)	FB
110085(d)(e)		-	68	(102	D+E)	-	52	222	33	15.0	(3.6)	10.2	(20.3)	15.8	(31.5)	FB
110086	-	-	115	85	-	-	-	200	7	------Self-Contained------						
110087	-	-	-	442	-	-	-	442	41	27.5	(6.6)	67.5	(135.0)	16.9	(33.7)	F
110088	-	-	-	43	-	-	-	43	29	27.1	(6.5)	--	(--)	--	(--)	F
110089	-	-	-	35	-	-	-	35	11	--	(--)	--	(--)	--	(--)	
110090	-	-	54	3	20	-	-	77	22	11.7	(2.8)	11.3	(22.6)	7.5	(14.9)	F
110091	-	-	24	36	30	-	-	90	27	13.4	(3.2)	8.0	(15.9)	8.9	(17.8)	FB
110092	-	-	-	200	-	-	-	200	6	1.3	(0.3)	3.8	(7.5)	2.2	(4.3)	FB
110093	-	-	49	91	-	-	-	140	30	29.6	(7.1)	--	(--)	28.0	(55.9)	F
110094	-	-	-	-	-	99	-	99	21	--	(--)	--	(--)	--	(--)	
110095	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	30	12.5	(3.0)	21.7	(43.3)	4.0	(7.9)	F
110096	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	29	--	(--)	--	(--)	--	(--)	

TABLE III-20 (Continued)

Mill No.	Production Profile (t/d) (a) A	B	C	D	E	F	G	Total	Percent Corrugated Furnish	Raw Waste Load Flow kl/kkg	Flow (kgal/t)	BOD5 kg/kkg	BOD5 (lb/t)	TSS kg/kkg	TSS (lb/t)	≤BPT(b)
110097	1	-	93	-	-	-	112	206	92	15.9	(3.8)	10.3	(20.5)	2.1	(4.2)	FB
110098	40	-	5	54	8	-	1	128	53	13.8	(3.3)	--	(--)	--	(--)	F
110099	-	282	-	108	-	-	-	390	80	8.8	(2.1)	--	(--)	1.4	(2.8)	F
110100	-	-	61	-	-	-	-	61	60	12.9	(3.1)	--	(--)	--	(--)	F
110101	-	-	-	-	-	198	-	198	33	9.6	(2.3)	3.5	(7.0)	3.7	(7.3)	FB
110102	-	-	-	-	50	-	-	50	0	--	(--)	--	(--)	--	(--)	
110103	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	80	--	(--)	--	(--)	--	(--)	
110104	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	74	--	(--)	--	(--)	--	(--)	
110105	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	80	1.3	(0.3)	1.6	(3.1)	0.1	(0.2)	FB
110106	-	-	-	-	-	192	70	262	42	12.1	(2.9)	27.8	(55.6)	16.3	(32.5)	F
110107	-	-	-	(114	D+E)	-	-	114	16	-----Self-Contained-----						
110108	-	-	-	90	-	-	-	90	3	--	(--)	--	(--)	--	(--)	
110110	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	43	9.6	(2.3)	11.2	(22.4)	13.3	(26.5)	FB
110111	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	21	17.1	(4.1)	3.6	(7.2)	4.2	(8.4)	FB
110112	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	21	8.8	(2.1)	3.4	(6.8)	5.0	(10.0)	FB
110113	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	62	15.9	(3.8)	5.1	(10.1)	34.0	(68.0)	FB
110114	-	-	-	136	-	-	-	136	26	6.7	(1.6)	2.5	(5.0)	0.1	(0.2)	FB
110115	-	6	200	-	-	-	-	206	43	--	(--)	--	(--)	--	(--)	
110116	-	-	-	-	-	-	27	27	0	-----Self-Contained-----						
110117	-	-	-	6	3	-	70	79	46	5.4	(1.3)	4.4	(8.7)	3.4	(6.7)	FB
110118	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	0	14.6	(3.5)	--	(--)	--	(--)	F
110119	-	-	-	-	-	-	54	54	44	28.0	(6.7)	6.1	(12.1)	2.8	(5.5)	FB
110120	-	-	30	-	-	-	12	42	32	10.8	(2.6)	7.5	(15.0)	1.5	(3.0)	FB
110121	-	74	-	-	96	-	-	170	69	7.1	(1.7)	1.2	(2.4)	1.5	(2.9)	FB
110123	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	53	18.4	(4.4)	11.0	(22.0)	9.4	(18.8)	FB
110124	27	-	101	-	-	-	-	128	2	45.5	(10.9)	12.8	(25.5)	32.6	(65.2)	
110125	-	-	-	6	24	-	69	99	3	1.3	(0.3)	1.0	(2.0)	1.5	(3.0)	FB
110126	-	-	-	195	-	-	-	195	29	23.4	(5.6)	0.8	(1.5)	0.5	(0.9)	FB
110127	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	45	52.2	(12.5)	12.5	(25.0)	19.5	(39.0)	
110128	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	69	--	(--)	--	(--)	--	(--)	
110129	-	-	14	76	-	-	-	90	38	--	(--)	--	(--)	--	(--)	
110130	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	14	6.7	(1.6)	--	(--)	--	(--)	F
110131(e)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	54	14.2	(3.4)	1.9	(3.8)	0.3	(0.6)	FB
110133(e)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	74	--	(--)	--	(--)	--	(--)	
110134	-	-	38	-	-	-	-	38	40	--	(--)	--	(--)	--	(--)	
110135	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	47	-----Self-Contained-----						
110138	-	-	66	41	-	11	-	118	41	18.8	(4.5)	8.9	(17.7)	18.1	(36.1)	FB
110140	-	-	-	-	-	220	-	220	45	10.0	(2.4)	4.9	(9.8)	4.9	(9.7)	FB
110141(g)	20	-	49	30	-	-	5	104	15	20.0	(4.8)	--	(--)	--	(--)	F
110142	61	-	-	12	-	16	122	211	95	-----Self-Contained-----						
110143	-	-	85	-	-	-	123	208	53	9.2	(2.2)	7.0	(13.9)	--	(--)	FB
110144	-	-	7	13	42	-	-	62	24	--	(--)	--	(--)	--	(--)	
110145(e)	-	-	-	234	-	-	-	234	42	--	(--)	--	(--)	--	(--)	
110146	-	23	20	-	-	-	-	43	98	-----Self-Contained-----						
110147(f)	-	49	15	-	-	-	-	64	--	7.1	(1.7)	1.1	(2.2)	0.7	(1.4)	FB
110148	-	-	-	-	115	-	-	115	22	10.8	(2.6)	1.8	(3.5)	2.2	(4.4)	FB

TABLE III-20 (Continued)

	Production Profile (t/d) (a)								Percent Corrugated Furnish	Raw Waste Load						
										Flow		BOD5		TSS		
Mill No.	A	B	C	D	E	F	G	Total		kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	≤BPT(b)
110149	-	3	-	-	-	-	-	3	73	1.7	(0.4)	--	(--)	--	(--)	F
110150	25	35	-	-	-	-	-	60	57	--	(--)	--	(--)	--	(--)	
110151	20	28	-	-	-	-	-	48	55	--	(--)	--	(--)	--	(--)	
110152	-	-	(115	C+D+E)		-	-	115	18	12.9	(3.1)	4.3	(8.6)	6.4	(12.8)	FB
150019	-	-	-	-	-	-	1	1	0	20.0	(4.8)	--	(--)	--	(--)	F
Average of <100 percent corrugated furnish mills (w/o self-contained mills)										19.2	(4.6)	9.2	(18.4)	10.4	(20.8)	
BPT Raw Waste Load										30.0	(7.2)	11.3	(22.5)	11.0	(21.9)	
Average of <100 percent corrugated furnish mills ≤BPT flow										14.2	(3.4)	8.8	(17.5)	8.7	(17.4)	
Average of <100 percent corrugated furnish mills ≤BPT BOD5										17.5	(4.2)	5.9	(11.7)	7.8	(15.5)	
Corrugating Medium Furnish																
110010	-	-	-	-	-	-	10	10	100	--	(--)	--	(--)	--	(--)	
110014	-	90	-	-	-	-	-	90	100	3.3	(0.8)	13.2	(26.4)	11.1	(22.2)	FB
110025	45	408	-	-	-	-	-	453	100	10.8	(2.6)	19.3	(38.6)	2.3	(4.6)	FB
110028	-	83	-	-	-	-	-	83	100	0.8	(0.2)	0.6	(1.2)	1.3	(2.6)	FB
110030	-	126	-	-	-	-	-	126	100	5.0	(1.2)	--	(--)	5.1	(10.2)	F
110049	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	100	2.9	(0.7)	5.4	(10.7)	2.8	(5.6)	FB
110054	-	97	-	-	-	-	-	97	100	--	(--)	--	(--)	--	(--)	
110057	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	100	30.5	(7.3)	17.5	(35.0)	28.5	(57.0)	B
110073	-	150	-	-	-	-	-	150	100	------------------Self-Contained------------------						
110139	23	87	-	-	-	-	-	110	100	--	(--)	--	(--)	--	(--)	
Average of 100 percent corrugated furnish mills (w/o self-contained mills)										8.8	(2.1)	11.2	(22.4)	8.5	(17.0)	
BPT Raw Waste Load										30.0	(7.2)	23.0	(46.0)	11.0	(21.9)	
Average of 100 percent corrugated furnish mills ≤BPT flow										4.6	(1.1)	9.6	(19.2)	4.5	(9.0)	
Average of 100 percent corrugated furnish mills ≤BPT BOD5										8.8	(2.1)	11.2	(22.4)	8.5	(17.0)	
Average of All Mills (w/o self-contained mills)										18.4	(4.4)	9.2	(18.4)	10.2	(20.3)	
Average of All Mills ≤BPT flow										13.4	(3.2)	8.7	(17.4)	8.3	(16.6)	

(a) A = Linerboard
B = Corrugating
C = Chip & Filter Board
D = Folding Board
E = Set-up Board
F = Gypsum Wallboard
G = Other Board Products
(b) F-Mills ≤BPT flow; B-Mills with ≤BPT BOD5.
(c) Production data held confidential.
(d) Production from 2 mills.
(e) Mill is now closed.
(f) Not included in averages of mills employing corrugating furnish as corrugating data were not provided by mill personnel.
(g) Mill self-contained through spray irrigation of mill effluent.

TABLE III-21

SUMMARY RAW WASTE LOAD DATA
WASTEPAPER-MOLDED PRODUCTS SUBCATEGORY

	Production Profile			Raw Waste Load					
		Product		Flow		BOD5		TSS	
Mill No.	Furnish	(t/d)	Type	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
150002(a)(c)	WP	20.0	Pipe, Conduit	20.4	(4.9)	4.6	(9.2)	20.1	(40.1)
150004(c)	WP	2.8	Egg Cartons	74.7	(17.9)	--	(--)	--	(--)
150005(a)	WP	5.5	Containers	25.0	(6.0)	2.4	(4.7)	8.4	(16.7)
150006(c)	GWD, Pulp Substitute	43.7	Molded Products	46.3	(11.1)	10.4	(20.7)	18.9	(37.7)
150007	WP	(b)	Molded Products	89.7	(21.5)	15.9	(31.7)	23.7	(47.3)
150009(a)	News, GWD Substitute	(b)	Molded Products	18.8	(4.5)	--	(--)	0.5	(1.0)
150010(a)	News	60.0	Molded Products	31.3	(7.5)	9.4	(18.8)	15.0	(30.0)
150011	News, Blank, Purch GWD, K	(b)	Egg Cartons, Trays	71.4	(17.1)	10.5	(20.9)	23.4	(46.7)
150021	News, GWD, Peat Moss	16.6	Molded Products, Peat Moss	173.2	(41.5)	5.2	(10.4)	11.2	(22.3)
150022	Box Cuttings GWD Substitute	61.8	Molded Products	54.7	(13.1)	7.6	(15.2)	16.8	(33.6)
150023	GWD, BLK 9% WP	186.0	Molded Products	86.8	(20.8)	8.6	(17.2)	10.9	(21.7)
150024	K, GWD, 55% WP	93.4	Molded Products	85.1	(20.4)	5.1	(10.2)	12.8	(25.6)
150025	News	26.5	Molded Products	110.2	(26.4)	0.2	(0.4)	0.9	(1.8)
150028	K, GWD Substitute	11.0	Flower Pots	-----------Self-contained-----------					
150030	News	3.0	Molded Products	--	(--)	--	(--)	--	(--)
Average (w/o self-contained mill)				68.4	(16.4)	7.3	(14.5)	13.5	(27.0)
Average of Recycle Mills (w/o self-contained mill)				23.8	(5.7)	5.5	(10.9)	11.0	(22.0)
Average of Non-Recycle Mills (w/o self-contained mill)				88.1	(21.1)	7.9	(15.8)	14.8	(29.6)
BPT Raw Waste Load				88.1	(21.1)	7.9	(15.8)	14.8	(29.6)

(a) Mill recycles significant amount of process wastewater.
(b) Production data held confidential.
(c) Mill is closed.

BPT TSS RWL [14.8 kg/kkg (29.6 lb/t)].

Builders' Paper and Roofing Felt - Available RWL data for mills in this subcategory are presented in Table III-22. The mills have been divided into the following four groups based on the furnish employed: mills with a predominantly wastepaper furnish, mills with furnish including TMP, mills with furnish including other types of groundwood, and mills with other types of furnish. The May 1974 development document supporting the promulgated Phase I regulations (Reference Number 30) for this subcategory did not indicate the basis for BPT BOD5 and TSS RWLs. The BPT BOD5 final effluent mass load was found by assuming that an 87.5 percent reduction of BOD5 by biological treatment was representative of BPT and by applying that reduction to the BOD5 RWL from a single mill. The BPT final effluent TSS load also was based only on BPT flow and the final effluent TSS concentration from the same mill. Therefore, instead of the BPT BOD5 RWL, the BOD5 RWL of the mill that was the basis for BPT effluent limitations [12.6 kg/kkg (25.2 lb/t)] was used for comparison to determine BCT Option 1 raw waste BOD5. BCT Option 1 flow for this subcategory is the average flow of all mills in the subcategory where flows lower than the BPT flow are attained. The average BOD5 RWL is higher for the group of mills using furnish including TMP than for the other three groups of mills in the subcategory. Therefore, BCT Option 1 BOD5 RWL is the average BOD5 RWL of mills at which groundwood TMP is used and where BOD5 RWLs are attained that are lower than the comparison level [12.6 kg/kkg (25.2 lb/t)].

Application of these methodologies yields BCT Option 1 flow and BOD5 RWL of 11.3 kl/kkg (2.7 kgal/t) and 7.4 kg/kkg (14.8 lb/t). The BCT Option 1 TSS RWL is assumed to be the same as the TSS RWL [41.0 kg/kkg (82.0 lb/t)] of the mill from which the comparison level BOD5 RWL and BPT BOD5 final effluent were obtained.

Nonintegrated-Fine Papers - Available RWL data for mills in the wood fiber furnish sector and the cotton fiber furnish sector of this subcategory are presented in Table III-23. In the development of BCT Option 1 RWL, data were reviewed considering waste significant grade changes in three specific delineations: 1) none, 2) less than one, and 3) greater than one waste significant grade change per day. A correlation is apparent; flow and BOD5 RWL increase with increasing frequency of grade changes. BCT Option 1 RWLs for the nonintegrated-fine papers subcategory are based on the highest averages for the various grade change delineations for mills where RWLs are attained that are lower than the BPT RWLs. Application of this methodology for the wood fiber furnish sector yields BCT Option 1 for flow and BOD5 RWL of 39.2 kl/kkg (9.4 kgal/t) and 7.5 kg/kkg (14.9 lb/t). Application of this methodology for the cotton fiber furnish sector yields BCT Option 1 flow and BOD5 RWL of 130.2 kl/kkg (31.2 kgal/t) and 14.0 kg/kkg (28.0 kg/kkg). The BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [30.8 kg/kkg (61.6 lb/t) for the wood fiber furnish sector and 55.2 kg/kkg (110.4 lb/t) for the cotton fiber furnish sector].

TABLE III-22

SUMMARY RAW WASTE LOAD DATA
BUILDERS' PAPER AND ROOFING FELT SUBCATEGORY

		Production Profile				Raw Waste Load						
		Product			Subgroup	Flow		BOD5		TSS		
Mill No.	Furnish	(t/d)	Type	Finish(a)	(b)	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	≤BPT(e)
1. Mills with Furnish Including TMP												
120003	WP, Chips	(d)	Construction Paper		T	8.3	(2.0)	--	(--)	--	(--)	F
120012	WP, TMP	228	Construction Paper	S	T	2.9	(0.7)	8.9	(17.8)	2.9	(5.8)	FB
120017	WP, TMP	73	Roofing Felt	S	T	-----------------	-----------------	Self-Contained	-----------------	-----------------	-----------------	
120018	WP, TMP	88	Roofing Felt	U	T	-----------------	-----------------	Self-Contained	-----------------	-----------------	-----------------	
120019	WP, TMP	156	Roofing Felt	U	T	4.2	(1.0)	--	--	7.4	(14.7)	F
120020	WP, Chips, TMP	82	Roofing Felt	U	T	-----------------	-----------------	Self-Contained	-----------------	-----------------	-----------------	
120024	WP, TMP	126	Roofing Felt	U	T	2.1	(0.5)	3.4	(6.8)	2.4	(4.7)	FB
120026	TMP, Chips	71	Construction Paper	S	T	-----------------	-----------------	Self-Contained	-----------------	-----------------	-----------------	
120028	WP, TMP	193	Roofing Felt	U	T	40.9	(9.8)	22.1	(44.2)	17.7	(35.4)	F
120029	WP, TMP	39	Roofing Felt	U	T	-----------------	-----------------	Self-Contained	-----------------	-----------------	-----------------	
120031	TMP, Chips	167	Construction Paper	S	T	16.7	(4.0)	6.2	(12.4)	6.0	(12.0)	FB
120032(f)	WP, TMP	77	Construction Paper	U	T	43.4	(10.4)	25.7	(51.4)	40.9	(81.8)	F
120033	WP, TMP	60	Construction Paper	U	T	0.8	(0.2)	--	(--)	--	(--)	F
120055	TMP, WF	334	Construction Paper	S	T	-----------------	-----------------	Self-Contained	-----------------	-----------------	-----------------	
120057	TMP, WP	125	Construction Paper		T	13.8	(3.3)	14.1	(28.2)	15.3	(30.5)	F
120058	TMP, WP, Rag	118	Construction Paper	U	T	-----------------	-----------------	Self-Contained	-----------------	-----------------	-----------------	
120059	TMP, WP	140	Builders Paper	U	T	-----------------	-----------------	Self-Contained	-----------------	-----------------	-----------------	
Average (w/o self-contained mills)						13.4	(3.2)	13.4	(26.8)	13.2	(26.4)	
BPT Raw Waste Load						60.0	(14.4)	17.5	(35.0)	35.0	(70.0)	
Comparison Level Raw Waste Load								12.6	(25.2)	41.0	(82.0)	
Average of Mills with ≤ BPT flow (w/o self-contained mills)						14.6	(3.5)	13.4	(26.8)	13.2	(26.4)	
Average of Mills with ≤ comparison level BOD5 (w/o self-contained mills)						7.1	(1.7)	6.2	(12.3)	3.8	(7.5)	
2. Mills with Predominantly Wastepaper Furnish												
120001	WP, WF	32	Construction Paper	S	W	65.1	(15.6)	--	(--)	--	(--)	
120002	WP, WF, Rag	116	Construction Paper Roofing Felt	U	W	3.3	(0.8)	--	(--)	--	(--)	F
120008	WP, WF	(d)	Construction Paper Roofing Felt	S	W	26.3	(6.3)	--	(--)	--	(--)	F
120009	WP, WF	40	Construction Paper	S	W	--	--	--	(--)	--	(--)	
120010	WP, WF	29	Construction Paper	S	W	28.8	(6.9)	2.1	(4.2)	2.3	(4.6)	FB
120011	WP, Chips	345	Construction Paper	S	T	7.5	(1.8)	12.8	(25.5)	5.1	(10.1)	F
120013(f)	WP, Chips	97	Construction Paper	U	T	13.8	(3.3)	33.4	(66.8)	10.1	(20.2)	F
120014	WP, Baled Pulp	21	Construction Paper	U	W	--	--	--	(--)	--	(--)	
120015	WP, Chips	92	Construction Paper	U	T	5.0	(1.2)	11.2	(22.3)	4.1	(8.2)	FB
120016	WP, GWD	30	Roofing Felt	U	T	7.1	(1.7)	--	(--)	--	(--)	F
120021(c)	WP, GWD	172	Roofing Felt	U	T	48.4	(11.6)	281.2	(562.4)	33.4	(66.8)	

TABLE III-22 (cont.)

	Production Profile					Raw Waste Load						
		Product			Subgroup	Flow		BOD5		TSS		
Mill No.	Furnish	(t/d)	Type	Finish(a)	(b)	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	SBPT(e)
3. Mills with Furnish Including Other Types of Groundwood (cont.)												
120006	WP, GWD	123	Construction Paper	U	G	----------------Self-Contained------------------						
120007	WP, GWD	90	Construction Paper	S	G	----------------Self-Contained------------------						
120027	WP, GWD	20	Construction Paper	S	G	----------------Self-Contained------------------						
Average (w/o self-contained mills)						2.9	(0.7)	4.8	(9.6)	1.8	(3.6)	
BPT Raw Waste Load						60.0	(14.4)	17.5	(35.0)	35.0	(70.0)	
Comparison Level Raw Waste Load								12.6	(25.2)	41.0	(82.0)	
Average of mills with ≤ BPT flow (w/o self-contained mills)						2.9	(0.7)	4.8	(9.6)	1.8	(3.6)	
Average of mills with ≤ comparison level BOD5 (w/o self-contained mills)						2.9	(0.7)	4.8	(9.6)	1.8	(3.6)	
4. Mills with Other Types of Furnish												
120051	WF, Purch Pulp	60	Construction Paper	U	O	----------------Self-Contained------------------						
120054	WP, WF	60	Builders Board	U	O	7.9	(1.9)	3.9	(7.7)	6.5	(13.0)	FB
120056	WP, WF	242	Builders Board	S	O	----------------Self-Contained------------------						
Average (w/o self-contained mills)						7.9	(1.9)	3.9	(7.7)	6.5	(13.0)	
BPT Raw Waste Load						60.0	(14.4)	17.5	(35.0)	35.0	(70.0)	
Comparison Level Raw Waste Load								12.6	(25.2)	41.0	(82.0)	
Average of mills with ≤ BPT flow (w/o self-contained mills)						7.9	(1.9)	3.9	(7.7)	6.5	(13.0)	
Average of mills with ≤ comparison level BOD5 (w/o self-contained mills)						7.9	(1.9)	3.9	(7.7)	6.5	(13.0)	
Average of all mills (w/o self-contained mills)						8.3	(2.0)	11.7	(23.4)	8.6	(17.1)	
Average of all mills with ≤ BPT flow (w/o self-contained mills)						11.3	(2.7)	11.2	(22.3)	12.1	(24.2)	
Average of all mills with ≤ comparison level BOD5 (w/o self-contained mills)						8.8	(2.1)	5.2	(10.4)	4.6	(9.1)	

(a) S = Saturated; U = Unsaturated.
(b) W = Predominantly wastepaper furnish.
T = Furnish includes TMP.
G = Furnish includes other types of groundwood.
O = Other furnish.
(c) Mill recycles significant amount of process wastewater. Not included in averages.
(d) Production data held confidential.
(e) F - mill with ≤BPT flow; B - mill with ≤ BPT BOD5.
(f) Mill is closed.

TABLE III-22 (cont.)

		Production Profile				Raw Waste Load						
		Product				Flow		BOD5		TSS		
Mill No.	Furnish	(t/d)	Type	Finish(a)	Subgroup (b)	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	≤BPT(e)
2. Mills with Predominantly Wastepaper Furnish (cont.)												
120022(f)	WP, WF, Rag	53	Construction Paper	U	W	12.5	(3.0)	5.1	(10.1)	8.0	(15.9)	FB
120023(f)	WP, Chips	75	Roofing Felt	U	T	19.2	(4.6)	--	(--)	--	(--)	F
120025	WP, WF, Rag	44	Roofing Felt Construction Paper	U	W	9.6	(2.3)	24.0	(48.0)	71.6	(143.2)	F
120030	WP, WF, Rag	28	Roofing Felt Construction Paper	S	W	5.8	(1.4)	2.2	(4.3)	6.9	(13.8)	FB
120034	WP, WF, Rag	30	Construction Paper	U	W	Self-Contained						
120035(f)	WP, WF, Rag	71	Construction Paper Construction Felt	S	W	--	(--)	--	(--)	--	(--)	
120036	WP, WF, Rag	54	Construction Paper Construction Felt	S	W	--	(--)	--	(--)	--	(--)	
120037	WP, WF, Rag	49	Construction Paper Construction Felt	U	W	--	(--)	--	(--)	--	(--)	
120038	WP, WF, Rag	51	Construction Paper Construction Felt	S	W	5.4	(1.3)	--	(--)	--	(--)	F
120040(f)	WP, WF, Rag	44	Construction Paper	S	W	Self-Contained						
120041	(d)	(d)	Construction Paper	S	(d)	Self-Contained						
120042	WP, WF, Rag	55	Construction Paper	S	W	--	(--)	--	(--)	--	(--)	
120043	WP, WF, Rag	43	Construction Paper	S	W	4.6	(1.1)	--	(--)	--	(--)	F
120044	WP, WF, Rag	21	Construction Paper	S	W	--	(--)	--	(--)	--	(--)	
120045	WP, WF, Rag	36	Construction Paper	S	W	0.4	(0.1)	--	(--)	--	(--)	F
120046	WP, WF, Rag	72	Construction Paper	S	W	--	(--)	--	(--)	--	(--)	
120047	WP, WF, Rag	63	Construction Paper	U	W	4.6	(1.1)	--	(--)	--	(--)	F
120048	WP, WF, Rag	40	Construction Paper	S	W	Self-Contained						
120049	WP, WF	22	Construction Paper	S	W	--	(--)	--	(--)	--	(--)	
120050	WP, WF, Rag	55	Construction Paper	U	W	10.0	(2.4)	5.0	(9.9)	7.6	(15.2)	FB
120052	WP, WF	39	Construction Paper	U	W	--	(--)	--	(--)	--	(--)	
Average (w/o self-contained mills)						13.4	(3.2)	12.0	(23.9)	14.5	(28.9)	
BPT Raw Waste Load						60.0	(14.4)	17.5	(35.0)	35.0	(70.0)	
Comparison Level Raw Waste Load								12.6	(25.2)	41.0	(82.0)	
Average of mills with ≤ BPT flow (w/o self-contained mills)						10.4	(2.5)	1.2	(2.4)	14.5	(28.9)	
Average of mills with ≤ Comparison level BOD5 (w/o self-contained mills)						12.5	(3.0)	5.1	(10.2)	5.8	(11.5)	
3. Mills with Furnish Including Other Types of Groundwood												
120004	WP, Rags, GWD	69	Construction Paper	S	G	4.2	(1.0)	5.5	(10.9)	1.5	(2.9)	FB
120005	WP, GWD	170	Asbestos Felt Organic Felt	U	G	1.3	(0.3)	4.2	(8.3)	2.2	(4.3)	FB

TABLE III-23

SUMMARY RAW WASTE LOAD DATA
NONINTEGRATED-FINE PAPERS SUBCATEGORY

Mill Number	Production Profile: Percent Cotton Furnish	Production Profile: (t/d)	Production Profile: Product	Production Profile: Grade Change /Day(a)	Raw Waste Load: Flow kl/kkg	Raw Waste Load: Flow (kgal/ton)	Raw Waste Load: BOD5 kg/kkg	Raw Waste Load: BOD5 (lb/ton)	Raw Waste Load: TSS kg/kkg	Raw Waste Load: TSS (lb/ton)	≤BPT(b)
Wood Fiber Furnish											
080001	0	(c)	Unctd Print	+	26.7	(6.4)	9.0	(17.9)	14.0	(27.9)	FB
080005	1.5	63	Print, Thin, Cotton	+	35.1	(8.4)	--	(--)	--	(--)	F
080007(d)	0	165	Unctd Print	0	68.9	(16.5)	6.9	(12.8)	19.8	(39.6)	
080009	0	1088	Ctd & Unctd Print	+	76.8	(18.4)	5.9	(11.8)	25.0	(50.0)	B
080017	0	125	Ctd Print	U	----------Self-Contained----------						
080018	0	135	Unctd Print	U	24.6	(5.9)	--	(--)	--	(--)	F
080019	0	54	Unctd Print	-	17.9	(4.3)	--	(--)	--	(--)	F
080027	0	381	Ctd & Unctd Print	-	38.0	(9.1)	13.7	(27.3)	40.7	(81.3)	F
080028	0	81	Unctd Print	-	82.6	(19.8)	--	(--)	44.7	(89.3)	
080029	1.7	116	Print, Write, Ind Conv. Cotton	-	45.9	(11.0)	--	(--)	--	(--)	F
080030	0	74	Unctd Print	+	22.5	(5.4)	--	(--)	--	(--)	F
080031	0	(c)	Unctd Print	+	43.0	(10.3)	--	(--)	--	(--)	F
080033	0	15	Unctd	+	96.8	(23.2)	25.6	(51.2)	85.0	(170.0)	
080034	0	(c)	Unctd	-	25.9	(6.2)	5.8	(11.5)	10.2	(20.4)	FB
080037	0	742	Ctd Print, Board	0	21.7	(5.2)	7.7	(15.4)	17.0	(34.0)	FB
080038	0	(c)	Ctd & Unctd Print	U	44.7	(10.7)	10.5	(20.9)	43.5	(87.0)	FB
080040	0	587	Ctd Print	-	86.0	(20.6)	16.9	(33.8)	115.2	(230.3)	
080041	0	412	Print, Write, Pkg	-	110.6	(26.5)	14.9	(29.8)	47.8	(95.5)	
080045	0.8	144	Unctd Print	-	33.0	(7.9)	10.8	(21.6)	41.8	(83.6)	F
080046	0	455	Unctd Print	-	61.3	(14.7)	13.8	(27.6)	31.5	(62.9)	F
080047	0	191	Unctd Print	U	11.7	(2.8)	3.3	(6.5)	4.5	(8.9)	FB
080048	0	173	Unctd Print	+	50.5	(12.1)	11.1	(22.1)	18.3	(36.5)	F
080049	0	(c)	Unctd Print	+	48.4	(11.6)	--	(--)	--	(--)	F
080051	0	35	Unctd Print	U	73.9	(17.7)	--	(--)	--	(--)	
080053	0	267	Unctd Print	-	53.0	(12.7)	3.8	(7.6)	24.4	(48.8)	FB
080055	0	(c)	Unctd Print, Sat	0	54.2	(13.0)	--	(--)	--	(--	F
105021	0	115	Ctd Print, Electrical	-	71.4	(17.1)	--	(--)	--	(--)	
105036	0	(c)	Base Stock, Thin	-	--	(--)	--	(--)	--	(--)	
105047	0	103	Ctd Pkg	U	79.7	(19.1)	--	(--)	18.3	(36.6)	
Average (w/o self-contained mill)					52.2	(12.5)	10.9	(21.8)	35.4	(70.7)	
Average - no grade change					48.4	(11.6)	7.7	(15.4)	18.4	(36.8)	
Average - <1 grade change/day					56.8	(13.6)	11.4	(22.7)	44.5	(89.0)	
Average - >1 grade change/day					50.1	(12.0)	12.9	(25.8)	35.6	(71.1)	
BPT Raw Waste Load					63.0	(15.2)	10.8	(21.5)	30.8	(61.6)	
Average ≤BPT Flow - no grade changes					38.0	(9.1)	7.7	(15.4)	17.0	(34.0)	
Average ≤BPT BOD5_ - no grade changes					21.7	(5.2)	7.7	(15.4)	17.0	(34.0)	
Average ≤BPT Flow - <1 grade change/day					39.2	(9.4)	9.6	(19.1)	29.7	(59.4)	

TABLE III-23 (Continued)

	Production Profile				Raw Waste Load						
					Flow		BOD5		TSS		
Mill Number	Percent Cotton Furnish	(t/d)	Product	Grade Change /Day(a)	kl/kkg	(kgal/ton)	kg/kkg	(lb/ton)	kg/kkg	(lb/ton)	≤BPT(b)
Average ≤BPT BOD5 - <1 grade change/day					39.6	(9.5)	4.8	(9.6)	17.3	(34.6)	
Average ≤BPT Flow - >1 grade change/day					37.6	(9.0)	10.0	(20.0)	16.1	(32.2)	
Average ≤BPT BOD5 - >1 grade change/day					51.7	(12.4)	7.5	(14.9)	19.5	(39.0)	
Cotton Fiber Furnish											
080003	24.0	25	Cotton	U	149.4	(35.8)	6.0	(12.0)	7.0	(14.0)	FB
080004	26.0	13	Cotton	U	88.9	(21.3)	17.9	(35.7)	65.0	(130.0)	FB
080032	4.3	(c)	Unctd Rag	+	118.1	(28.3)	12.1	(24.2)	29.4	(58.7)	FB
080042	5.0	43	Unctd Cotton,Carbon	U	78.9	(18.9)	19.5	(39.0)	44.8	(89.6)	FB
080043	15.0	30	Unctd Print,Artist,Cotton	+	269.2	(64.5)	40.7	(81.4)	86.5	(173.0)	
080044	16.1	71	Unctd Print Cotton	+	141.9	(34.0)	15.9	(31.7)	49.7	(99.4)	FB
080050	16.7	33	Unctd Print Cotton	U	25.5	(6.1)	13.7	(27.3)	15.2	(30.3)	FB
Average					124.4	(29.8)	18.0	(35.9)	42.5	(85.0)	
Averge - > 1 grade change/day					176.5	(42.3)	22.9	(45.8)	55.2	(110.4)	
BPT Raw Waste Load					176.5	(42.3)	22.9	(45.8)	55.2	(110.4)	
Average of Mills ≤BPT Flow and ≤ BPT BOD5- >1 grade change/day					130.2	(31.2)	14.0	(28.0)	39.6	(79.1)	

(a) - = <1; + = >1; U = unknown.
(b) F-Mill with ≤BPT flow; B-Mill with ≤BPT BOD5.
(c) Production data held confidential.
(d) Raw waste load BOD5 data after primary treatment; BOD5 data are not included in averages.

Nonintegrated-Tissue Papers - Available RWL data for this subcategory are presented in Table III-24. In the development of BCT Option 1 RWL, data were reviewed considering the frequency of waste significant grade changes. In general, flow and BOD5 RWLs increase with increasing frequency of waste significant grade changes.

BCT Option 1 RWLs for this subcategory are based on the highest averages for the various grade change delineations for mills where RWLs are attained that are lower than the BPT RWLs. Application of this methodology yields BCT Option 1 flow and BOD5 RWL of 79.7 kl/kkg (19.1 kgal/t) and 9.0 kg/kkg (17.9 lb/t). The BCT Option 1 flow is the average of flows at mills with greater than one waste significant grade change per day. The BCT Option 1 BOD5 RWL is the average BOD5 at mills where less than one waste significant grade change occurs per day. The BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [34.7 kg/kkg (69.4 lb/t)].

Nonintegrated-Lightweight Papers - Available RWL data for the two sectors of this subcategory, lightweight papers and lightweight electrical papers, are presented in Table III-25. In the development of BCT Option 1 RWL, data were reviewed considering the frequency of waste significant grade changes. Flow and BOD5 RWL increase with increasing frequency of waste significant grade changes. BCT Option 1 flows for each sector are the highest average flow for the various grade change delineations for mills where flows are attained that are lower than the BPT flow. BCT Option 1 BOD5 RWL loads are the highest average BOD5 RWL of the various grade change delineations for mills where BOD5 RWL is lower than the BPT BOD5 RWL. The BCT Option 1 BOD5 for the lightweight electrical papers product sector is identical to that for the lightweight papers product sector. Application of this methodology yields BCT Option 1 flow and BOD5 RWL of 159.4 kl/kkg (38.2 kgal/t) and 13.3 kg/kkg (26.6 lb/t) for the lightweight papers sector and flow and BOD5 RWL of 278.8 kl/kkg (66.8 kgal/t) and 13.3 kg/kkg (26.6 lb/t) for the lightweight electrical papers sector. For both sectors, the BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [63.4 kg/kkg (126.8 lb/t)].

Nonintegrated-Filter and Nonwoven Papers - Available RWL data for mills in this subcategory are presented in Table III-26. In the development of BCT Option 1 RWLs, data were reviewed considering waste significant grade changes. BCT Option 1 RWLs are based on the highest averages for the various grade change delineations for mills where RWLs are lower than the BPT RWLs. Application of this methodology yields BCT Option 1 flow and BOD5 RWL of 198.2 kl/kkg (47.5 kgal/t) and 9.0 kg/kkg (17.9 lb/t). The BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [27.4 kg/kkg (54.7 lb/t)].

Nonintegrated-Paperboard - Available RWL data for this subcategory are presented in Table III-27. In the development of BCT Option 1 RWL, data were reviewed considering the frequency of waste significant grade changes. BCT Option 1 RWLs are the

TABLE III-24

SUMMARY RAW WASTE LOAD DATA
NONINTEGRATED-TISSUE PAPERS SUBCATEGORY

	Production Profile							Raw Waste Load						
	Furnish				Product		Grade	Flow		BOD5		TSS		
Mill No.	Purch	GWD	DI	WP	(t/d)	Type	Change/Day(a)	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	SBPT(b)
090001	23	--	--	5	20	Industrial Tissue	0	104.3	(25.0)	4.5	(9.0)	5.0	(10.0)	B
090005(e)	(c)	(c)	(c)	(c)	(c)	Sanitary Tissue	0	23.0	(5.5)	5.6	(11.2)	11.5	(22.9)	FB
090007	(c)	(c)	(c)	(c)	(c)	Sanitary Tissue	-	78.0	(18.7)	8.0	(15.9)	28.5	(57.0)	FB
090008	(c)	(c)	(c)	(c)	(c)	Sanitary Tissue	0	96.8	(23.2)	15.3	(30.6)	47.1	(94.2)	
090009	(c)	(c)	(c)	(c)	(c)	Sanitary Tissue	-	89.7	(21.5)	9.9	(19.7)	25.7	(51.4)	FB
090011(e)	62	--	--	12	70	Sanitary Tissue	-	78.9	(18.9)	--	(--)	--	(--)	F
090012	62	--	--	--	59	Sanitary Tissue	-/w	35.9	(8.6)	--	(--)	--	(--)	F
090013(d)	34	1	--	3	37	Sanitary Tissue	U	63.8	(15.3)	6.3	(12.6)	40.0	(80.0)	F
090016	(c)	(c)	(c)	(c)	(c)	Sanitary Tissue	U	56.8	(13.6)	18.0	(36.0)	53.2	(106.4)	F
090017	(c)	(c)	(c)	(c)	(c)	Sanitary Tissue	-/w	56.3	(13.5)	14.9	(29.7)	48.3	(96.5)	F
090018(e)	(c)	(c)	(c)	(c)	(c)	Sanitary Tissue	-	80.1	(19.2)	12.8	(25.6)	43.9	(87.8)	F
090019	139	19	--	48	159	Sanitary Tissue	U	103.5	(24.8)	--	(--)	--	(--)	
090020	887	57	--	5	890	Sanitary Tissue	+	79.7	(19.1)	22.9	(45.7)	54.5	(108.9)	F
090021	119	11	--	40	176	Mixed Product	+	170.7	(40.9)	--	(--)	31.2	(62.3)	
090022	154	7	--	--	189	Mixed Product	-	66.8	(16.0)	9.1	(18.2)	26.9	(53.7)	FB
090023	(c)	(c)	(c)	(c)	(c)	Mixed Product	-/w	30.9	(7.4)	--	(--)	15.8	(31.5)	F
090024	(c)	(c)	(c)	(c)	(c)	Sanitary Tissue	0	--	(--)	--	(--)	--	(--)	
090025	6	--	--	--	6	Mixed Product	-	286.7	(68.7)	14.6	(29.1)	14.6	(29.1)	
090026	21	--	5	28	50	Sanitary Tissue	U	74.7	(17.9)	17.4	(34.8)	53.8	(107.6)	F
090027	140	--	--	--	140	Sanitary Tissue	0	17.9	(4.3)	0.7	(1.3)	4.1	(8.2)	FB
090028(d)(e)(c)		(c)	(c)	(c)	(c)	Sanitary Tissue	U	143.6	(34.4)	--	(--)	--	(--)	
090029	41	--	--	14	44	Industrial Tissue	0	94.7	(22.7)	--	(--)	--	(--)	F
090030	(c)	(c)	(c)	(c)	(c)	Sanitary Tissue	0	32.5	(7.8)	1.7	(3.3)	6.6	(13.1)	FB
090031	14	--	--	4	17	Mixed Product	-/W	98.1	(23.5)	--	(--)	--	(--)	
090032	26	--	--	4	27	Mixed Product	-	177.8	(42.6)	--	(--)	--	(--)	
090033	15	--	--	1	14	Mixed Product	0	29.6	(7.1)	1.0	(2.0)	5.8	(11.5)	FB
Average								85.5	(20.5)	10.4	(20.8)	28.0	(56.0)	
Average - Industrial Tissue Only								99.7	(23.9)	4.5	(9.0)	5.0	(10.0)	
Average - no grade changes								57.2	(13.7)	4.8	(9.6)	13.4	(26.7)	
Average - <1 grade change/week								55.5	(13.3)	14.9	(29.7)	32.0	(64.0)	
Average - <1 grade change/day								122.7	(29.4)	10.9	(21.7)	27.9	(55.8)	
Average - >1 grade change/day								125.2	(30.0)	22.9	(45.7)	42.8	(85.6)	
BPT Raw Waste Load								96.0	(22.9)	11.5	(22.9)	34.7	(69.4)	
Average of Mills with SBPT flow - No grade changes								39.6	(9.5)	2.3	(4.5)	7.0	(13.9)	
Average of Mills with SBPT BOD5 - No grade changes								41.3	(9.9)	2.7	(5.4)	6.6	(13.1)	
Average of Mills with SBPT flow - <1 grade change/week								40.9	(9.8)	14.9	(29.7)	32.0	(64.0)	
Average of Mills with SBPT BOD5 - <1 grade change/week								--	(--)	--	(--)	--	(--)	
Average of Mills with SBPT flow - <1 grade change/day								78.9	(18.9)	10.0	(19.9)	31.3	(62.5)	
Average of Mills with SBPT BOD5 - <1 grade change/day								78.0	(18.7)	9.0	(17.9)	27.0	(54.0)	
Average of Mills with SBPT flow - >1 grade change/day								79.7	(19.1)	22.9	(45.7)	54.5	(108.9)	
Average of Mills with SBPT BOD5 - >1 grade change/day								--	(--)	--	(--)	--	(--)	

(a) - = <1; -/w = <1/week; U = unknown.
(b) F-Mill with SBPT flow; B-Mill with SBPT BOD5.
(c) Production data held confidential.
(d) Flow, BOD5 and TSS data not included in averages because they do not represent a true raw waste load.
(e) Mill is now closed.

TABLE III-25

SUMMARY RAW WASTE LOAD DATA
NONINTEGRATED-LIGHTWEIGHT PAPERS SUBCATEGORY

	Profile Profile						Raw Waste Load						
	Furnish (t/d)				Product	Grade	Flow		BOD5		TSS		≤BPT
Mill No.	Purch	WP	Misc	Broke	(t/d)	Change/Day(a)	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	(g)
Electrical Paper													
105003(f)	11.2	--	--	--	11.2	-	446.9	(107.1)	--	(--)	--	(--)	
105015	(b)	(b)	(b)	(b)	(b)	0	313.0	(75.0)	--	(--)	--	(--)	F
105017	(b)	(b)	(b)	(b)	(b)	0	269.2	(64.5)	--	(--)	--	(--)	F
105018(c)	(b)	(b)	(b)	(b)	(b)	0	755.3	(181.0)	--	(--)	--	(--)	
105071	26.0	--	--	--	26.3	U	254.1	(60.9)	11.4	(22.8)	19.1	(38.1)	FB
Average							320.9	(76.9)	11.4	(22.8)	19.1	(38.1)	
Miscellaneous Tissue and Carbonized (Lightweight Papers)													
090015	47.4	25.6	--	--	64.2	+	224.9	(53.9)	57.7	(115.3)	149.9	(299.8)	
105057	33.0	5.1	--	--	34.0	0	147.3	(35.3)	2.9	(5.7)	5.2	(10.3)	FB
105058	34.0	4.9	--	--	35.0	-	208.7	(50.0)	11.8	(23.6)	25.7	(51.4)	B
Average							193.6	(46.4)	24.1	(48.2)	60.3	(120.5)	
Printing & Thin Paper (Lightweight Papers)													
080039(f)	(b)	(b)	(b)	(b)	(b)	+	236.6	(56.7)	29.4	(58.8)	127.1	(254.2)	
105014	(b)	(b)	(b)	(b)	(b)	-	170.7	(40.9)	--	(--)	--	(--)	F
105020	203.0	4.0	2.0	--	203.0	-	202.4	(48.5)	8.3	(16.5)	15.6	(31.1)	FB
Average							203.2	(48.7)	18.9	(37.7)	71.4	(142.7)	
Carbonized, Thin, Cigarette - Less Wastepaper (Lightweight Papers)													
080024	29.6	--	--	5.3	32.5	0	60.5	(14.5)	--	(--)	--	(--)	F
080021(d)	30.3	--	--	--	26.9	0	10.8	(2.6)	0.2	(0.3)	0.1	(0.2)	FB
080022	102.4	11.3	--	--	110.5	-	--	(--)	--	(--)	--	(--)	
090003	12.0	1.6	--	4.4(e)	18.0	-	128.9	(30.9)	--	(--)	--	(--)	F
105013	15.1	--	5.3	--	20.4	-	135.2	(32.4)	19.9	(39.7)	57.0	(114.0)	FB
105016	(b)	(b)	(b)	(b)	(b)	-	517.5	(124.0)	--	(--)	--	(--)	
Average							210.7	(50.5)	19.9	(39.7)	57.0	(114.0)	
Average of All Mills							237.0	(56.8)	20.2	(40.3)	57.1	(114.1)	
Average of Electrical							320.9	(76.9)	11.4	(22.8)	19.1	(38.1)	
Average w/o Electrical							203.2	(48.7)	21.7	(43.3)	63.4	(126.8)	
BPT Raw Waste Load Electrical Papers							320.9	(76.9)	21.7	(43.3)	63.4	(126.8)	
BPT Raw Waste Load Lightweight Papers							203.2	(48.7)	21.7	(43.3)	63.4	(126.8)	
Average of mills - no grade change and flow ≤ BPT flow - Lightweight Papers w/o Electrical							103.9	(24.9)	2.9	(5.7)	5.2.	(10.3)	
Average of mills - no grade change and BOD5 ≤ BPT BOD5							147.3	(35.3)	2.9	(5.7)	5.2	(10.3)	
Average of mills - <1 grade change/day and flow ≤ BPT flow - Lightweight Papers							159.4	(38.2)	14.1	(28.1)	36.3	(72.6)	
Average of mills - <1 grade change per day and BOD5 ≤ BPT BOD5							181.9	(43.6)	13.3	(26.6)	32.8	(65.5)	
Average of Electrical paper mills - flow ≤ BPT flow - Electrical Papers							278.8	(66.8)	11.4	(22.8)	19.1	(38.1)	

(a) - = <1; + = >1; U = unknown.
(b) Production data held confidential.
(c) Represents a combination of process sewer and a very high flow from a thermal sewer. Apparently, mill must use high flow on thermal sewer to meet thermal discharge limits. Not included in averages.
(d) After primary clarification; not included in average.
(e) Estimated to balance.
(f) Mill is now closed.
(g) F - Mill with ≤ BPT flow; B - Mill with ≤ BPT BOD5.

TABLE III-26

SUMMARY RAW WASTE LOAD DATA
NONINTEGRATED-FILTER AND NONWOVEN PAPERS SUBCATEGORY

	Production Profile			Raw Waste Load						
	Product		Grade	Flow		BOD5		TSS		
Mill No.	(t/d)	Type	Change/Day(a)	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	≤BPT(c)
105005	5.9	Saturated Filter & Nonwoven	-	328.8	(78.8)	--	(--)	24.3	(48.6)	
105029	4.1	Technical & Filter	U	144.0	(34.5)	18.2	(36.4)	14.7	(29.3)	F
105030	(b)	Filter	O	189.9	(45.5)	--	(--)	--	(--)	F
105031	0.7	Filter	O	394.3	(94.5)	--	(--)	--	(--)	
105033	(b)	Filter, Wall Cover Miscellaneous	+	224.1	(53.7)	--	(--)	--	(--)	F
105034	(b)	Filter	+	172.3	(41.3)	--	(--)	--	(--)	F
105043	(b)	Filter, Blotting, Photo	+	280.4	(67.2)	25.0	(49.9)	54.8	(109.5)	
105044	(b)	Filter, Blotting, Pkg	O	25.9	(6.2)	3.8	(7.5)	12.8	(25.5)	FB
105045	(b)	Filter, Pkg	U	40.1	(9.6)	--	(--)	--	(--)	F
105051	(b)	Filter, Sat Tech	-	171.1	(41.0)	5.0	(9.9)	19.4	(38.8)	FB
105052	(b)	Filter	O	17.9	(4.3)	--	(--)	--	(--)	F
105053	(b)	Filter	O	42.6	(10.2)	--	(--)	--	(--)	F
105054	(b)	Filter, Photo, Wrap	U	6.7	(1.6)	--	(--)	--	(--)	F
105055	(b)	Filter, Saturated	+	288.4	(69.1)	9.0	(17.9)	38.3	(76.5)	B
Average of All Mills				166.1	(39.8)	12.2	(24.3)	27.4	(54.7)	
Average of mills - no grade change				134.0	(32.1)	3.8	(7.5)	12.8	(25.5)	
Average of mills - <1 grade change/day				250.0	(59.9)	5.0	(9.9)	21.9	(43.7)	
Average of mills - >1 grade change/day				241.2	(57.8)	17.0	(33.9)	46.5	(93.0)	
BPT Raw Waste Load				250.0	(59.9)	12.2	(24.3)	27.4	(54.7)	
Average of Mills - no grade change and flow ≤ BPT flow				69.3	(16.6)	3.8	(7.5)	12.8	(25.5)	
Average of Mills - no grade changes and BOD5 ≤ BPT BOD5				25.9	(6.2)	3.8	(7.5)	12.8	(25.5)	
Average of Mills - >1 grade change/day and flow ≤ BPT flow				198.2	(47.5)	--	(--)	--	(--)	
Average of Mills - >1 one grade change/day and BOD5 ≤ BPT BOD5				288.4	(69.1)	9.0	(17.9)	38.3	(76.5)	

(a) - = <1; + = >1; U + Unknown.
(b) Production data held confidential.
(c) F - Mill with ≤ BPT flow; B - Mill with ≤ BPT BOD5.

TABLE III-27

SUMMARY RAW WASTE LOAD DATA
NONINTEGRATED-PAPERBOARD SUBCATEGORY

	Production Profile					Raw Waste Load						
	Furnish(t/d)		Product		Grade	Flow		BOD5		TSS		
Mill No.	Purch	WP	(t/d)	Type	Change/Day(a)	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	≤BPT(c)
085001	60.0	12	84.0	Packaging, Bag	+	29.6	(7.1)	--	(--)	--	(--)	F
085007	(b)	(b)	(b)	Matrix Board	U	184.9	(44.3)	--	(--)	--	(--)	
085008	32.0	22	50.0	Pkg, Bag, Specialty	U	62.6	(15.0)	10.0	(20.0)	25.0	(50.0)	B
085010	(b)	(b)	(b)	Matrix Board	U	168.2	(40.3)	7.0	(13.9)	46.4	(92.7)	B
105001	33.5	--	38.2	Food Board, Gift	0	30.0	(7.2)	8.2	(16.4)	43.2	(86.4)	FB
105002	9.2	--	8.4	Hi Dens Electrical	U	273.3	(65.5)	--	(--)	--	(--)	
105039	(b)	(b)	(b)	Latex, Sat Gaskets	-	48.8	(11.7)	--	(--)	--	(--)	F
105048	46.0	--	62.0	Impregnated Fiber	-	38.8	(9.3)	--	(--)	--	(--)	F
105049	44.0	--	51.0	Impregnated Fiber	-	53.0	(12.7)	--	(--)	--	(--)	F
105070	(b)	(b)	(b)	Electrical Board	U	221.6	(53.1)	87.5	(175.0)	136.5	(272.9)	
105073	17.1	--	15.0	Saturated Paper for Vulcanizing	U	105.6	(25.3)	13.0	(26.0)	42.4	(84.7)	
110021	47.4	36.6	76.0	Press Board	U	63.0	(15.1)	--	(--)	--	(--)	
Average						106.8	(25.6)	25.2	(50.3)	58.7	(117.3)	
Average w/o Electrical						78.5	(18.8)	9.6	(19.1)	39.3	(78.5)	
Average w/o Electrical or Matrix						53.8	(12.9)	10.4	(20.8)	36.9	(73.7)	
BPT Raw Waste Load						53.8	(12.9)	10.4	(20.8)	36.9	(73.7)	
Average of Mills - no grade change and flow ≤ BPT flow						30.0	(7.2)	8.2	(16.4)	43.2	(86.4)	
Average of Mills - no grade change and BOD5 ≤ BPT BOD5						30.0	(7.2)	8.2	(16.4)	43.2	(86.4)	
Average of Mills - <1 grade change/day and flow ≤ BPT flow						46.7	(11.2)	--	(--)	--	(--)	
Average of Mills - <1 grade change/day and BOD5 ≤ BPT BOD5						--	(--)	--	(--)	--	(--)	
Average of Mills - >1 grade change/day and flow ≤ BPT flow						29.6	(7.1)	--	(--)	--	(--)	
Average of Mills - >1 grade change/day and BOD5 ≤ BPT BOD5						--	(--)	--	(--)	--	(--)	

(a) - = <1; + = >1; U = Unknown.
(b) Production data held confidential.
(c) F - Mill with ≤ BPT flow; B - Mill with ≤ BPT BOD5.

highest averages for the various grade change delineations for mills (excluding those that produce electrical or matrix board) with RWLs that are lower than the BPT RWLs. Application of this methodology yields BCT Option 1 flow and BOD5 RWL of 46.7 kl/kkg (116.2 kgal/t) and 8.2 kg/kkg (16.4 lb/t). The BCT Option 1 TSS RWL is assumed to be the same as the BPT TSS RWL [36.9 kg/kkg (73.7 lb/t)].

Summary of Option 1 Raw Waste Loads - Table III-28 presents a summary of BCT Option 1 raw waste loads.

Development of BCT Option 1 Final Effluent Characteristics

BCT Option 1 includes (a) the implementation of production process controls that are applicable to each subcategory but have not been widely applied at mills in the subcategory and (b) the end-of-pipe treatment technology which is the basis for BPT for each subcategory. Biological treatment was the effluent treatment technology identified as the basis for BPT for most subcategories. Because of flow reductions resulting from the application of production process controls, the end-of-pipe systems have longer detention times than if BPT RWLs were being treated in the systems. Therefore, they are more effective in removing conventional pollutants. The reduced BOD5 load to the treatment system will also result in further reductions in the effluent BOD5 and TSS loads.

In the December 1976 development document supporting the final BPT regulations for Phase II subcategories, an equation was developed relating the anticipated final effluent BOD5 concentration to the BOD5 concentration entering a biological treatment system (See Phase II Development Document, page 402).(9) This equation, based on treatment plant performance data, is as follows:

$$\text{Log BOD5 effluent (mg/l)} = [0.601 \times \text{Log BOD5 influent (mg/l)}] - 0.020$$

This equation is used to predict long-term average BCT Option 1 final effluent BOD5 loads based on the application of biological treatment to the BCT Option 1 RWLs of the subcategories for which the equation was developed (dissolving kraft, market bleached kraft, BCT bleached kraft, fine bleached kraft, soda and the groundwood subcategories, and the fine papers and tissue papers sectors of the deink subcategory).

The use of the equation has been transferred to the unbleached kraft, semi-chemical, unbleached kraft and semi-chemical, paperboard from wastepaper (non-corrugating medium furnish), tissue from wastepaper, and builders' paper and roofing felt subcategories to predict BCT Option 1 long-term average final effluent BOD5 loads. Biological treatment was the BPT technology basis for each of these subcategories. In addition, the required BOD5 removals from BPT RWL to BPT final effluent levels for these subcategories are approximately equal to the removals required

TABLE III-28
BCT OPTIONS 1 AND 3
LONG-TERM AVERAGE RAW WASTE LOADS

	Flow		BOD5		TSS	
	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
Integrated Segment						
Dissolving Kraft	208.7	(50.0)	60.4	(120.7)	113.0	(226.0)
Market Bleached Kraft	154.8	(37.1)	31.8	(63.6)	45.0	(90.0)
BCT Bleached Kraft	123.9	(29.7)	35.1	(70.2)	66.5	(133.0)
Alkaline-Fine[1]	99.7	(23.9)	30.4	(60.8)	75.0	(150.0)
Unbleached Kraft						
o Linerboard	40.5	(9.7)	14.9	(29.8)	21.9	(43.8)
o Bag	48.0	(11.5)	21.9	(43.8)	21.9	(43.8)
Semi-Chemical	30.5	(7.3)	17.6	(35.2)	12.3	(24.6)
Unbleached Kraft and Semi-Chemical	48.0	(11.5)	16.3	(32.5)	20.5	(41.0)
Dissolving Sulfite Pulp[2]						
o Nitration	233.7	(56.0)	90.6 [64.1]	(181.2 [128.2])	92.5	(185.0)
o Viscose	233.7	(56.0)	92.6 [65.6]	(185.2 [131.2])	92.5	(185.0)
o Cellophane	233.7	(56.0)	109.6 [80.1]	(219.2 [160.2])	92.5	(185.0)
o Acetate	260.4	(62.4)	157.0 [126.5]	(314.0 [253.0])	92.5	(185.0)
Papergrade Sulfite[3]	(4)	(4)	(4)	(4)	90.0	(180.0)
Groundwood-Thermo-Mechanical	--	--	--	--	--	--
Groundwood-CMN Papers	70.1	(16.8)	13.3	(26.6)	48.5	(97.0)
Groundwood-Fine Papers	64.3	(15.4)	12.5	(24.9)	52.5	(105.0)
Secondary Fibers Segment						
Deink						
o Fine Papers	44.2	(10.6)	68.9	(137.7)	202.5	(405.0)
o Tissue Papers	52.2	(12.5)	94.6	(189.2)	202.5	(405.0)
o Newsprint	--	--	--	--	--	--
Tissue From Wastepaper	68.0	(16.3)	9.7	(19.3)	110.5	(221.0)
Paperboard From Wastepaper						
o Corrugating Medium Furnish	13.4	(3.2)	23.0	(46.0)	11.0	(21.9)
o Noncorrugating Medium Furnish	13.4	(3.2)	11.3	(22.5)	11.0	(21.9)
Wastepaper-Molded Products	23.8	(5.7)	5.5	(10.9)	14.8	(29.6)
Builders' Paper and Roofing Felt	11.3	(2.7)	7.4	(14.8)	41.0	(82.0)
Nonintegrated Segment						
Nonintegrated-Fine Papers						
o Wood Fiber Furnish	39.2	(9.4)	7.5	(14.9)	30.8	(61.6)
o Cotton Fiber Furnish	130.2	(31.2)	14.0	(28.0)	55.2	(110.4)
Nonintegrated-Tissue Papers	79.7	(19.1)	9.0	(17.9)	34.7	(69.4)
Nonintegrated-Lightweight Papers						
o Lightweight	159.4	(38.2)	13.3	(26.6)	63.4	(126.8)
o Electrical	278.8	(66.8)	13.3	(26.6)	63.4	(126.8)
Nonintegrated-Filter and Nonwoven Papers	198.2	(47.5)	9.0	(17.9)	27.4	(54.7)
Nonintegrated-Paperboard	46.7	(11.2)	8.2	(16.4)	36.9	(73.7)

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[1] Includes Fine Bleached Kraft and Soda subcategories.

[2] Values in brackets are for mills which employ MgO. Neutralization of spent sulfite liquor is a BCT Option 1 internal control for mills employing MgO, with consequently greater reductions in BOD5.

[3] Includes Papergrade Sulfite (Blow Fit Wash) and Papergrade Sulfite (Drum Wash) subcategories.

[4] BCT Options 1 and 3 raw waste flow and BOD5 vary with the percent sulfite pulp in the final product. The following equations can be used to obtain annual average effluent characteristics for Papergrade Sulfite mills:

Mills Not Employing MgO	Mills Employing MgO
Flow (kℓ/kkg) = 34.64 + 1.561 x	34.64 + 1.561 x
Flow (kgal/t) = 8.30 + 0.374 x	8.30 + 0.374 x
BOD5 (kg/kkg) = 9.3 + 0.620 x	9.30 + 0.520 x
BOD5 (lb/t) = 18.6 + 1.24 x	18.6 + 1.040 x

where x equals the percent sulfite pulp produced on-site in the final product.

for the subcategories on which the relationship was based.

The relationship was also used to predict BCT Option 1 long-term average final effluent BOD5 levels for the wastepaper-molded products subcategory and the corrugating medium furnish sector of the paperboard from wastepaper subcategory since it was used to determine the BPT final effluent BOD5 loads from BPT BOD5 RWLs for this subcategory and sector (see October 1982 Development Document suporting the November 1982 regulations, pg. 391) (2). The methodology used to develop the BOD5 BCT Option 1 final effluent level for the nonintegrated-fine papers subcategory is discussed below.

Another equation relating secondary treatment system influent BOD5 concentration and anticipated final effluent BOD5 concentration was developed based on data from mills producing papergrade sulfite and dissolving sulfite pulp. This was developed at the same time as the above equation (See December 1976 Phase II Development Document, reference number 9, pg. 400):

$$\text{Log BOD5 effluent (mg/l)} = [0.496 \times \log \text{BOD5 influent (mg/l)}] + 0.309$$

This relationship predicts long-term average final effluent BOD5 loads based on the application of biological treatment to the BCT Option 1 RWLs in the papergrade sulfite and dissolving sulfite pulp subcategories.

EPA also developed a relationship between raw waste BOD5 concentration and final effluent TSS concentration; this equation's derivation is presented in Section VIII of the development document supporting the November 1982 final regulations, reference number 2, and is as follows:

$$\text{Final effluent TSS (mg/l)} = 8.95 \times [\text{Raw Waste BOD5 (mg/l)}]^{0.31}$$

This equation was developed from data representative of the dissolving kraft, market bleached kraft, fine bleached kraft, BCT (board, coarse, and tissue) bleached kraft, dissolving sulfite pulp, papergrade sulfite, soda, groundwood, and deink subcategories. This equation was used to determine BCT Option 1 long-term average final effluent TSS concentrations for all of the above subcategories except the deink subcategory and has also been applied to develop BCT Option 1 long-term average TSS concentrations for all the remaining subcategories for which biological treatment is the basis for BPT.

BCT Option 1 final effluent BOD5 and TSS concentrations have been developed from BCT Option 1 raw waste BOD5 concentrations using the appropriate equation relating secondary influent BOD5 concentration to final effluent BOD5 concentration and the equation relating secondary influent BOD5 concentration to final effluent TSS concentration. BCT Option 1 long-term average final effluent BOD5 and TSS mass loads were calculated by multiplying the long-term average final effluent BOD5 and TSS concentrations and the flow basis for BCT Option 1. This methodology was used to develop BCT Option 1 BOD5 and TSS final effluent characteristics for all the subcategories in the integrated segment (except groundwood-TMP), all subcategories in the secondary fibers segment (except for the deink subcategory, which is discussed below), and for TSS for the nonintegrated-fine papers subcategory.

As will be shown in the discussion of the development of BCT Option 4, the final effluent levels for BOD5 and TSS for the fine papers and the tissue papers sectors of the deink subcategory determined using the BCT Option 1 methodology are nearly identical to the corresponding effluent levels determined using the BCT Option 4 methodology. Therefore, the same effluent level will be used for both BCT Option 1 and BCT Option 4 for these sectors of the deink subcategory. The final effluent BOD5 loads determined using the BCT Option 1 methodology were slightly higher than those determined using the BCT Option 4 methodology for both sectors. Thus, the BCT Option 1 final effluent BOD5 effluent level was selected for the BCT Option 1 and BCT Option 4 levels. The final effluent TSS loads determined using the BCT Option 4 methodology were slightly higher than those determined using the BCT Option 1 methodology for both sectors; therefore, the BCT Option 4 final effluent TSS level was selected for the BCT Option 1 and BCT Option 4 levels. The technologies are considered interchangeable.

The development of BCT Option 1 final effluent levels for the papergrade sulfite subcategories followed the general methodology but requires further detailed discussion. BCT Option 1 final efflent levels for BOD5 and TSS for the papergrade sulfite subcategories were developed using a) the BCT Option 1 flow and BOD5 RWL equations relating these parameters with the percent sulfite pulp manufactured on-site (discussed above in the development of RWLs) and b) the equations relating raw waste BOD5 concentration to final effluent BOD5 and TSS concentrations. Cumbersome multi-term exponential equations were avoided when it was found that, for values of percent sulfite pulp greater than one percent, the relationships between final effluent BOD5 and TSS and percent sulfite pulp are virtually linear. To develop the relationship between final effluent BOD5 and the percent sulfite pulp, the flow and BOD5 RWL were predicted for several values of percent sulfite pulp using the equations for flow and raw waste BOD5 (for mills that do not employ MgO). The flow and BOD5 values were used to determine the influent BOD5 concentrations at the various values of percent sulfite pulp. These concentrations were substituted in the equation (for sulfite mills) relating influent BOD5 concentration to effluent BOD5 concentration to obtain predicted final effluent BOD5 concentrations at each value of percent sulfite pulp. These effluent concentrations, with the associated flow values, were used to calculate final effluent BOD5 loads for each value of percent sulfite pulp. The BOD5 effluent mass loads were plotted versus percent sulfite pulp, and the following relationship between BCT Option 1 final effluent BOD5 loads and percent sulfite pulp was obtained using a linear regression:

BCT Option 1 Final Effluent BOD5
(for mills that do not employ MgO)

final effluent BOD5 (kg/kkg) = 0.062x + 1.14
[final effluent BOD5 (lb/t) = 0.124x + 2.28]

where x = percent sulfite pulp manufactured on-site.

The process was repeated using the relationship between raw waste BOD5 concentration and final effluent TSS concentration to determine final effluent TSS as function of percent sulfite pulp. The BCT Option 1 TSS equation is as follows:

BCT Option 1 Final Effluent TSS
(for mills that do not employ MgO)

final effluent TSS (kg/kkg) = 0.090x + 1.76
[final effluent TSS (lb/t) = 0.179x + 3.52]

where x = percent sulfite pulp manufactured on-site.

These equations, representing BOD5 and TSS as a function of the percent sulfite pulp, were used to compute the BCT Option 1 long-term average final effluent characteristics for papergrade sulfite mills which do not employ MgO as a base.

Using the BCT Option 1 flow equation and the BOD5 equation developed for papergrade sulfite mills which employ MgO as a base, the procedures outlined above were followed to develop BCT Option 1 final effluent BOD5 and TSS equations for papergrade sulfite mills employing MgO as a base. The equations used to calculate BCT Option 1 final effluent BOD5 and TSS characteristics are as follows:

BCT Option 1
(For mills that employ MgO as a base)

final effluent BOD5 (kg/kkg) = 0.057x + 1.14
[final effluent BOD5 (lb/t) = 0.114x + 2.27]

final effluent TSS (kg/kkg) = 0.085x + 1.76
[final effluent TSS (lb/t) = 0.169x + 3.51]

The BCT Option 1 raw waste BOD5 concentrations for both the wood fibers and cotton fibers sectors of the nonintegrated-fine paper subcategory are approximately equal to the corresponding BPT raw waste BOD5 concentrations for these sectors as shown below:

	BOD5 Concentration (mg/l)	
	BPT	BCT Option 1
Wood fiber sector	170	190
Cotton fiber sector	130	107

Therefore, for both sectors of this subcategory, BCT Option 1 maximum 30-day average concentrations of BOD5 are expected to be equal to the corresponding BPT maximum 30-day average concentrations. The long-term annual average values shown in Table III-29 are obtained by dividing the maximum 30-day average values by the BCT Option 1 maximum 30-day variability factor for BOD5.

Primary treatment is the end-of-pipe technology basis for the nonintegrated-tissue papers, nonintegrated-lightweight papers, nonintegrated-filter and nonwoven papers, and nonintegrated paperboard subcategories. The BCT Option 1 long-term average raw waste BOD5 concentration for the nonintegrated-tissue papers subcategory is approximately equal to the BPT long-term average raw waste BOD5 concentration (112 mg/l vs. 120 mg/l). Therefore, BCT Option 1 long-term average final effluent concentrations of BOD5 and TSS are expected to equal the corresponding BPT long-term average final effluent concentrations which are 36.6 mg/l for BOD5 and 29.8 mg/l for TSS. Because the wastewater characteristics of the remaining nonintegrated subcategories are similar to those of the nonintegrated-tissue papers subcategory, BCT Option 1 long-term average BOD5 and TSS effluent concentrations of the nonintegrated-tissue papers subcategory have been transferred to the remaining nonintegrated subcategories (excluding nonintegrated-fine papers). Thus, BCT Option 1 final effluent BOD5 and TSS loads for each of the nonintegrated subcategories (excluding nonintegrated-fine papers) are determined by multiplying the BCT Option 1 BOD5 and TSS effluent concentrations (equal to the BPT effluent concentrations for the nonintegrated-tissue papers subcategory) by the subcategory BCT Option 1 flow.

Table III-29 presents a summary of the BCT Option 1 long-term average BOD5 and TSS effluent loads.

BCT Option 1 final effluent loads have been attained in 19 of the 20 subcategories where BPT is attained. Table III-30 summarizes the number of mills attaining BCT Option 1 final effluent loads and the number of direct discharging mills in each subcategory for which data were available. BCT Option 1 limits are attained at 70 percent of the mills in the integrated segment, 63 percent of the mills in the secondary fibers segment, and 80 percent of

TABLE III-29

BCT OPTION 1
LONG-TERM AVERAGE DISCHARGE CHARACTERISTICS

	Flow		BOD5		TSS	
	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
Integrated Segment						
Dissolving Kraft	208.7	(50.0)	6.0	(12.0)	10.8	(21.6)
Market Bleached Kraft	154.8	(37.1)	3.6	(7.3)	7.2	(14.4)
BCT Bleached Kraft	123.9	(29.7)	3.5	(7.0)	6.4	(12.8)
Alkaline-Fine[1]	99.7	(23.9)	3.0	(5.9)	5.3	(10.5)
Unbleached Kraft						
o Linerboard	40.5	(9.7)	1.3	(2.7)	2.3	(4.5)
o Bag	48.0	(11.5)	1.8	(3.6)	2.9	(5.7)
Semi-Chemical	30.5	(7.3)	1.3	(2.7)	2.0	(3.9)
Unbleached Kraft and Semi-Chemical	48.0	(11.5)	1.5	(3.0)	2.6	(5.2)
Dissolving Sulfite Pulp[2]						
o Nitration	233.7	(56.0)	9.2 [7.7]	(18.3 [15.4])	13.3 [11.9]	(26.5 [23.8])
o Viscose	233.7	(56.0)	9.2 [7.8]	(18.5 [15.6])	13.4 [12.0]	(26.7 [24.0])
o Cellophane	233.7	(56.0)	10.1 [8.6]	(20.1 [17.2])	14.1 [12.8]	(28.1 [25.5])
o Acetate	260.4	(62.4)	12.7 [11.4]	(25.4 [22.8])	17.0 [15.9]	(33.9 [31.7])
Papergrade Sulfite[3]	(4)	(4)	(4)	(4)	(4)	(4)
Groundwood-Thermo-Mechanical	--	--	--	--	--	--
Groundwood-CMN Papers	70.1	(16.8)	1.6	(3.1)	3.2	(6.4)
Groundwood-Fine Papers	64.3	(15.4)	1.5	(2.9)	2.9	(5.9)
Secondary Fibers Segment						
Deink						
o Fine Papers	44.2	(10.6)	2.5	(5.0)	3.3	(7.6)
o Tissue Papers	52.2	(12.5)	3.2	(6.5)	4.2	(8.3)
o Newsprint	--	--	--	--	--	--
Tissue From Wastepaper	68.0	(16.3)	1.3	(2.6)	1.3	(5.7)
Paperboard From Wastepaper						
o Corrugating Medium Furnish	13.4	(3.2)	1.1	(2.2)	1.2	(2.4)
o Noncorrugating Medium Furnish	13.4	(3.2)	0.73	(1.5)	0.97	(1.9)
Wastepaper-Molded Products	23.8	(5.7)	0.60	(1.2)	1.1	(2.3)
Builders' Paper and Roofing Felt	11.3	(2.7)	0.53	(1.1)	0.76	(1.5)
Nonintegrated Segment						
Nonintegrated-Fine Papers						
o Wood Fiber Furnish	39.2	(9.4)	1.5	(3.0)	1.8	(3.6)
o Cotton Fiber Furnish	130.2	(31.2)	3.8	(7.5)	5.0	(9.9)
Nonintegrated-Tissue Papers	79.7	(19.1)	2.9	(5.8)	2.4	(4.7)
Nonintegrated-Lightweight Papers						
o Lightweight	159.4	(38.2)	5.8	(11.7)	4.7	(9.5)
o Electrical	278.8	(66.8)	10.2	(20.4)	8.3	(16.6)
Nonintegrated-Filter and Nonwoven Papers	198.2	(47.5)	7.3	(14.5)	5.9	(11.8)
Nonintegrated-Paperboard	46.7	(11.2)	1.7	(3.4)	1.4	(2.8)

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[1] Includes Fine Bleached Kraft and Soda subcategories.

[2] Values in brackets are for mills which employ MgO. Neutralization of spent sulfite liquor is a BCT Option 1 internal control for mills employing MgO, with consequently greater reductions in BOD5.

[3] Includes Papergrade Sulfite Blow Pit Wash and Papergrade Sulfite Drum Wash subcategorier.

[4] BCT Option 1 effluent characteristics vary with the percent sulfite pulp in the final product. The following equations can be used to obtain annual average effluent characteristics for paper grade sulfite mills:

Mills not employing MgO	Mills employing MgO
Flow (kl/kkg) = 34.64 + 1.561x	Flow (kℓ/kkg) = 34.64 + 1.561x
BOD5 (kg/kkg) = 1.14 + 0.062x	BOD5 (kg/kkg) = 1.14 + 0.057x
TSS (kg/kkg) = 1.76 + 0.090x	TSS (kg/kkg) = 1.76 + 0.085x

where x = the percent sulfite pulp produced on-site.

TABLE III-30

NUMBER OF FACILITIES THAT ATTAIN BPT AND BCT OPTION 1
FINAL EFFLUENT CHARACTERISTICS

	Mills with Available Data	Mills Attaining BPT F.E. Levels(a)	Mills Attaining BCT Option 1 F.E. Levels(a)
Integrated Segment			
Dissolving Kraft	3	1	1
Market Bleached Kraft	10	7	5
BCT Bleached Kraft	9	5	3
Alkaline-Fine[1]	16	6	5
Unbleached Kraft			
o Linerboard	15	7	4
o Bag	7	3	1
Semi-Chemical	15	4	2
Unbleached Kraft and Semi-Chemical	8	2	1
Dissolving Sulfite Pulp			
o Nitration	0	0	0
o Viscose	2	0	0
o Cellophane	1	0	0
o Acetate	2	0	0
Papergrade Sulfite[2]	12	4	4
Groundwood-Thermo-Mechanical			
Groundwood-CMN Papers	2	1	1
Groundwood-Fine Papers	7	6	5
Secondary Fibers Segment			
Deink			
o Fine Papers	3	2	0
o Tissue Papers	11	7	6
o Newsprint			
Tissue From Wastepaper	9	7	1
Paperboard From Wastepaper			
o Corrugating Medium Furnish	3	2	1
o Noncorrugating Medium Furnish	36	23	18
Wastepaper-Molded Products	4	1	0
Builders' Paper and Roofing Felt	5	4	3
Nonintegrated Segment			
Nonintegrated-Fine Papers			
o Wood Fiber Furnish	12	5	2
o Cotton Fiber Furnish	2	1	1
Nonintegrated-Tissue Papers[3]	11	6	5
Nonintegrated-Lightweight Papers[3]			
o Lightweight	4	4	4
o Electrical	1	1	1
Nonintegrated-Filter[3] and Nonwoven Papers[3]	1	1	1
Nonintegrated-Paperboard[3]	4	1	1

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[1] Includes Fine Bleached Kraft and Soda subcategories.

[2] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories.

[3] Includes only mills that do not use secondary treatment.

(a) F.E. = Final Effluent

the mills in the nonintegrated segment where BPT effluent limitations are attained.

OPTION 2

Chemically assisted clarification (CAC) technology is an end-of-pipe technology which has been demonstrated consistently to achieve significant reductions in the discharge of conventional pollutants from biological treatment systems on a full-scale basis. Hence, EPA has selected CAC technology as the basis for the development of BCT Option 2 effluent limitations for all integrated and secondary fibers subcategories and for the nonintegrated-fine papers subcategory. For these subcategories, primary treatment is the technology basis of BPT. For the remaining nonintegrated subcategories, for which primary pretreatment is the technology basis of BPT, the Option 2 technology includes the addition of biological treatment.

Presented below is a discussion of the available information on CAC performance with pulp, paper, and paperboard industry effluents. Following this discussion, the methodology used to develop Option 2 effluent limitations is reviewed.

CAC Treatment Performance

The available literature indicates that approximately 40 pulp, paper, and paperboard mills in the U.S. have investigated CAC as a means of improving the quality of their wastewater discharge. Most of the information is contained in reports of bench or pilot scale studies, although several full scale installations have been reported. A major portion of the information (data from 34 mills) is contained in the National Council of the Paper Industry for Air and Stream Improvement (NCASI) Technical Bulletin No. 364, "Laboratory and Field Experience With Chemically Assisted Clarification of Pulp and Paper Biologically Treated Effluents, January 1982." (10)

Technical Bulletin No. 364 provides jar test data for a total of 32 mills in 17 subcategories. Although the jar tests were all performed on biologically treated effluent, the report did not indicate if samples had been clarified prior to alum addition. However, based on the reported level of influent TSS, it is assumed that in most instances, samples of clarified wastewater were used. In addition, four companies contributed pilot plant and full scale performance data for the report.

The NCASI jar test data indicate that optimum alum dosage for TSS reduction varies widely from mill to mill with little apparent correlation to the type of biological treatment preceding CAC. Subcategory trends can be seen, however. Fifteen of the 32 mills supplying jar test data to NCASI were wholly in kraft pulping subcategories. The average minimum alum dosage at the kraft mills to achieve optimum TSS reduction without use of polyelectrolytes was 336 mg/l. Optimum performance was defined as the minimum alum dosage to achieve an effluent TSS concentration of 15 mg/l or less, or if a TSS concentration of 15 mg/l could not be achieved, the optimum performance was defined as the alum dosage that gave the greatest TSS reduction. The average dosages ranged from 148 to 550 mg/l. The effluent TSS concentrations ranged from 5 to 229 mg/l and averaged 34 mg/l; the average is 18 mg/l when the highest value is excluded. A final TSS concentration of 15 mg/l or less was achieved in approximately 50 percent of the trials. Attempts to attain a TSS level of 15 mg/l using only alum as a coagulant were unsuccessful at four of the five kraft mills. It should be noted that in most instances the pH of the wastewater was not adjusted for optimum performance prior to alum addition. The data are not sufficient to judge if polyelectrolytes were of benefit.

In comparison, jar test data from the following nine mills indicated that alum dosages of 400 to 800 mg/l were typically needed for optimum TSS removals in the soda (1 mill), sulfite (5 mills), semi-chemical (2 mills), and groundwood thermo-mechanical (1 mill) subcategories. However, one mill producing bleached sulfite pulp had difficulty achieving additional TSS removal even with alum dosages of 2,000 to 3,000 mg/l. Another mill producing dissolving pulp reported no TSS reductions at alum dosages up to 300 mg/l. A final effluent concentration of 15 mg/l was seldom achieved at these nine mills. Variable performance and influent TSS concentration, and the limited amount of subcategory-specific data make extrapolation of optimum alum dosage and optimum performance data difficult for these subcategories.

An additional five mills supplied jar test results to NCASI representing groundwood (1 mill), deink (1 mill), nonintegrated-fine papers (2 mills), and nonintegrated-tissue papers (1 mill) subcategories. The data clearly indicate that the alum dosage required for optimum TSS control in these subcategories is less than in those subcategories discussed previously. The average minimum alum dosage with no polyelectrolyte addition for this group was 160 mg/l with a range of 125 to 186 mg/l. The average effluent TSS in jar test trials at these mills using alum and no polyelectrolyte was 19 mg/l. As in previously discussed trials, the pH of the wastewater was not adjusted prior to alum addition. The NCASI jar test data are summarized in Table III-31.

The other major source of jar test data was provided in a December 1979 letter to EPA commenting on the September 1979 draft report entitled "Preliminary Data Base Review of BATEA Effluent Limitations Guidelines, NSPS, and Pretreatment Standards for the Pulp, Paper, and Paperboard Point Source Category."(11) The commenter provided jar test information collected at nine different mills. It is believed, however, that data for at least four of these mills were also reported by NCASI. The commenter's letter included data on mills producing the following: unbleached kraft (1 mill), sulfite (1 mill), unbleached kraft and semi-chemical (1 mill), paperboard from wastepaper (2 mills), groundwood (1 mill), bleached kraft and sulfite (1 mill), and bleached kraft and groundwood (2 mills). The average minimum alum dosage among eight of these mills for optimum TSS reduction

TABLE III-31
SUMMARY OF CHEMICALLY ASSISTED CLARIFICATION TECHNOLOGY PEFORMANCE TESTS
NCASI JAR TEST RESULTS

Subcategory and Mill	Treatment System(a)	BOD5(mg/l)		TSS(mg/l)		Alum (mg/l)	Polymer (mg/l)	pH adj., Final pH(b)
		In	Out	In	Out			
Bleached Kraft								
NCASI No. 1	AS	-	-	1660	41	360	-	Y, 5.0
No. 2	AS	-	-	136	36	190	-	Y, 5.0
No. 3	AS	24	7	47	9	321	-	N, 5.7-6.2
No. 4	AS	6	1	11	5	600	0	N, 4.9
No. 4	AS	6	7	11	1	300	2	N, 6.9
No. 4	AS	6	11	11	4	0	4	N, 7.9
No. 6	AS	12	4	60	10	280	-	N, 4.9
No. 11	AS	-	-	-	10-30	300-500	-	Y, -
No. 5	ASB	21	6	33	9	187	-	N, 5.6-5.9
No. 7	ASB	30	12	55	26	339	-	N, 6.5
No. 10	ASB	-	-	-	-	490	0	N, -
No. 12	ASB	17	2	25	13	170	0	N, 3.7-5.3
No. 13	ASB	37	<10	47	10	550	0	-
Bleached Kraft and Bleached Sulfite								
NCASI No. 8	AS	17	2	44	25	332	-	N, 5.5
Bleached Kraft and Dissolving Kraft Pulp								
NCASI No. 9	ASB	-	-	40	5	700	-	N, 5.8
No. 9	ASB	9	7	46	16	550	1	N, 5.7
Unbleached Kraft								
NCASI No. 14	ASB	137	81	514	229	300	0	N, 7.1
No. 14	ASB	137	90	514	240	200	1	N, 7.5
No. 15	ASB	50	14	137	19	300	0	N, 6.0-6.2
No. 16	ASB	19	5	124	29	148	0	N, 6.6-7.2
No. 17	ASB	31	9	84	13	400	0.004	Y, 6.2

TABLE III-31 (continued)

Subcategory and Mill	Treatment System(a)	BOD5(mg/l) In	BOD5(mg/l) Out	TSS(mg/l) In	TSS(mg/l) Out	Alum (mg/l)	Polymer (mg/l)	pH adj., Final pH(b)
Nonintgrated-Fine								
NCASI No. 30	AS	-	-	40	32	150	0	N, 5.9
No. 30	AS	24	27	18	14	150	1	N, 9.2
No. 31	AS	12	4	46	20	152	0	N, 4.0-6.3
Nonintegrated-Tissue								
NCASI No. 32	AS	5	2	13	11	186	0	N, 5.6-5.7
No. 32	AS	6	3	8	9	118	1	N, 6.1-6.3

(a) AS - Activated Sludge
ASB - Aerated Stabilization Basin

(b) pH adjustment
N pH was not adjusted
Y pH was adjusted

was 366 mg/l and ranged from 50 to 700 mg/l. Alum was reported ineffective for TSS control at one paperboard from wastepaper mill. The trends observed in the NCASI data were repeated in these data. The type of treatment preceding CAC had no apparent effect on alum dosage. The highest dosages were required by the sulfite and the unbleached kraft and semi-chemical effluents and the lowest alum dosage (125 mg/l) was required for groundwood effluent. TSS removals averaged 64 percent and effluent TSS concentrations averaged 18 mg/l at the eight mills where CAC was effective. These jar test data are summarized in Table III-32.

In addition to the jar test work reported to the Agency, H. Chen has discussed pilot plant performance at two mills in a separate technical paper.(12) These mills were among the nine discussed above. Chen's results indicated that alum coagulation followed by addition of 3 to 5 mg/l of non-ionic polymer was effective in reducing effluent TSS from 84 to 20 mg/l. Chen reported that at pilot clarifier overflow rates greater than approximately 300 gpd/ft^2, TSS removal performance deteriorated significantly.

Performance of CAC was reported for two full-scale trials and one full-scale installation by NCASI, and for full-scale installations by three individual mills in response to a 1983 EPA questionnaire. Data from these three latter full-scale installation are also referenced in the development document supporting the November 1982 regulations.(2) These data are summarized in Table III-33.

Several important conclusions can be drawn from this tabulated full-scale data. First, the data confirm that CAC can be used effectively at full-scale installations to reduce TSS levels in final effluents. Second, alum dosages within the range of 100 to 350 mg/l may be optimum for full-scale installations in the kraft and groundwood subcategories. Furthermore, pH adjustment and use of polyelectrolytes in conjunction with alum should be anticipated. Third, although one mill reported an average TSS discharge concentration of 11 mg/l, the full-scale data from other mills suggest that such low effluent concentrations may not be universally achievable, and that long-term average concentrations of 20-30 mg/l are more likely to be achieved. This is of particular interest since this level is higher than the 15 mg/l of TSS on which EPA previously based BCT Options 2 and 3. This does not mean that a long-term average TSS concentration of 15 mg/l cannot be designed for or achieved, only that additional data are needed to support this low level. In addition, the performance of CAC cannot be characterized in terms of "percent removal" but seems to be bound by a lower residual TSS concentration which is likely related to clarifier design and operation.

It should be noted that, based on available data, alum dosage did not appear stoichiometrically related to initial TSS concentration. This was noted by personnel reporting data from several mills and is evident from review of the available data. However, a relationship between wastewater alkalinity and alum

TABLE III-32
SUMMARY OF CHEMICALLY ASSISTED CLARIFICATION TECHNOLOGY PERFORMANCE TESTS
OTHER JAR TEST RESULTS

Mill	Subcategory	BOD5(mg/l)		TSS(mg/l)		Alum (mg/l)	Polymer (mg/l)	pH adj., (a) Final pH
		In	Out	In	Out			
A	Bleached Kraft & Sulfite	38	10	47	21	450	-	-
B	Sulfite	203	147	52	28	700	-	-
C	Unbleached Kraft & S-C(b)	112	30	179	12	700	-	-
D	Groundwood	63	38	39	13	125	-	-
E	Paperboard from Wastepaper	99	26	87	-	>500	-	-
F	Paperboard from Wastepaper	680	542	91	32	350	-	-
G	Bleached Kraft & Groundwood	100	70	43	19	400	-	-
H	Bleached Kraft & Groundwood	15	10	26	10	150	-	-
I	Unbleached Kraft	13	6	24	8	50	-	-
	Dissolving Kraft	-	-	-	0-51	300-350	2	Yes
	Unbleached Kraft	107	66(c)	78	13(c)	70(c)	-	-

(a) pH adjustment
(b) Unbleached Kraft and semi-chemical
(c) 24 hours settling

TABLE III-33
SUMMARY OF CHEMICALLY ASSISTED CLARIFICATION TECHNOLOGY PERFORMANCE TESTS
FULL SCALE TEST RESULTS

Mill	Subcategory	CAC(a) Influent	CAC		BOD5(mg/l)		TSS(mg/l)		Alum (mg/l)	Polymer (mg/l)	pH Control	Performance Period
			m^2/dm^2	$gpdf^2$	In	Out	In	Out				
NCASI No. 1	Bleached Kraft	2° Clar.	-	-	-	-	-	31	200-500	1-6	yes	16 Mos.
NCASI No. 34	Bleached Kraft	ASB eff	17.5	430	-	-	197	69	96-200	0-15	No	5 Mos.
NCASI No. 26	Semi-Chemical	-	20.4	500	Clarifer overflow rate too high, solids washout.							
030034	Alkaline-Fine	2° Clar.	10.3	252	(c)	(c)	(c)	(c)	315	2-6	yes	3 yrs.
060001	GW-Chem-Mech(b)	-					(c)	(c)	(c)	(c)		(c)
080027	Nonintegrated-Fine	RBC-M.Liq.	21.9	537	53(E)	29	180(E)	24	55($FeCl_3$)	1.1	yes	6 yrs.
900017	Deink-Newsprint	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)

(a) CAC - chemically assisted clarification
2° clar. - secondary clarifier
ASB eff - aerated stabilization basin effluent
RBC - M. Liq. - Rotating biological contactors - mixed liquor

(b) Groundwood - Chemical-Mechanical
(c) Data are held condifential
(E) Data are estimates

demand was reported at certain mills. Several investigators also reported that the optimum pH for TSS reduction was in the range of 5 to 6. Based on this information, it is hypothesized that most of the mills reporting data were effecting "sweep coagulation" as described by Packham and by Stumm and O'Melia. (References 13 and 14, respectively). In sweep coagulation, metal coagulants are added to the suspension being treated until the solution becomes supersaturated with the metal hydroxide. At that point, an amorphous metal hydroxide precipitate forms which enmeshes and sweeps suspended material from the supernatant liquid as it settles. The minimum solubility of aluminum hydroxide, a hydrolysis product of alum, occurs at approximately pH 5.5 under equilibrium conditions, which may explain the optimum pH range of 5 to 6.

Development of Option 2 Effluent Characteristics

BCT Option 2 requires the addition of chemically assisted clarification to further treat BPT final effluent discharges from all integrated and secondary fiber subcategories and from the nonintegrated-fine papers subcategory. Based on the demonstrated performance of the full and pilot-scale systems, chemically assisted clarification can be predicted to achieve a long-term average TSS effluent concentration of 25 mg/l. Option 2 BOD5 effluent concentrations have been estimated by assuming that a certain percentage of the BPT BOD5 is soluble (i.e., not removable by CAC) and the remaining BOD5 will be removed in direct proportion to TSS removal. Based on available information, EPA has estimated the soluble portion of BPT final effluent BOD5 to be 23 percent.(32) Table III-34 contains a summary of the estimated effluent BOD5 and TSS concentrations for Option 2. Long-term average loads are calculated from the long-term average concentrations and BCT Option 2 flow, and are presented in Table III-35.

For the remaining nonintegrated subcategories, for which primary treatment is the technology basis of BPT, the Option 2 technology is BPT technology plus the addition of biological treatment. The predicted final effluent BOD5 concentration for the nonintegrated-tissue papers subcategory is based on the equation relating BOD5 secondary influent concentration to BOD5 final effluent concentration (see the Phase II Development Document, reference number 9, page 402).

The long-term average final effluent BOD5 concentration for the nonintegrated-tissue papers subcategory was transferred to the remaining nonintegrated subcategories where biological treatment is the technology basis of BCT Option 2. Similarly, the long-term average final effluent TSS concentration was developed using the relationship between influent BOD5 concentration and final effluent TSS concentration discussed previously in this section. The long-term average BOD5 and TSS concentrations determined by application of this methodology are 17.0 mg/l and 39.5 mg/l. BOD5 and TSS loads are calculated from these long-term average concentrations and BCT Option 2 flow.

TABLE III-34

BCT OPTION 2
ALUM DOSAGE AND LONG-TERM AVERAGE
FINAL EFFLUENT BOD_5 AND TSS CONCENTRATIONS

	Alum Dosage (mg/l)	Flow (kgal/t)	BOD_5 (mg/l)	TSS (mg/l)
Integrated Segment				
Dissolving Kraft	300	55.1	18.9	25
Market Bleached Kraft	300	41.6	15.6	25
BCT Bleached Kraft	300	35.4	17.0	25
Alkaline Fine[1]	300	30.9	14.6	25
Unbleached Kraft				
o Linerboard	300	12.6	16.1	25
o Bag	300	12.6	20.3	25
Semi-Chemical	700	10.3	29.3	25
Unbleached Kraft and Semi-Chemical	700	14.0	21.7	25
Dissolving Sulfite Pulp				
o Nitration	700	66.0	21.3	25
o Viscose	700	66.0	22.7	25
o Cellophane	700	66.0	24.6	25
o Acetate	700	72.4	30.1	25
Papergrade Sulfite[2]	700	*	*	25
Groundwood TMP	--	--	--	--
Groundwood CMN	150	23.8	16.2	25
Groundwood Fine	150	21.9	16.2	25
Secondary Fibers Segment				
Deink				
o Fine Papers	150	24.4	26.3	25
o Tissue Papers	150	24.4	26.3	25
o Newsprint	--	--	--	--
Tissue From Wastepaper	150	25.2	24.0	25
Paperboard From Wastepaper				
o Corrugating	700	7.2	26.3	25
o Noncorrugating	700	7.2	20.6	25
Wastepaper Molded Products	150	21.1	11.5	25
Builder's Paper and Roofing Felt	150	14.4	25.5	25
Nonintegrated Segment				
Nonintegrated-Fine Papers				
o Wood Fiber Furnish	150	15.2	23.1	25
o Cotton Fiber Furnish	150	42.3	20.3	25
Nonintegrated-Tissue Papers	--	22.9	17	39.5
Nonintegrated-lightweight Papers				
o Lightweight	--	48.7	17	39.5
o Electrical	--	76.9	17	39.5
Nonintegrated-F&NW	--	59.9	17	39.5
Nonintegrated-Paperboard	--	12.9	17	39.5

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[1] Includes Fine Bleached Kraft and Soda Subcategories.

[2] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) Subcategories. Flow and BOD_5 vary with the percent sulfite pulp produced on-site.

TABLE III-35

BCT OPTION 2
LONG-TERM AVERAGE DISCHARGE CHARACTERISTICS

	Flow		BOD5		TSS	
	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
Integrated Segment						
Dissolving Kraft	229.9	(55.1)	4.3	(8.7)	5.7	(11.5)
Market Bleached Kraft	173.6	(41.6)	2.7	(5.4)	4.3	(8.7)
BCT Bleached Kraft	147.7	(35.4)	2.5	(5.0)	3.7	(7.4)
Alkaline-Fine[1]	128.9	(30.9)	1.9	(3.8)	3.2	(6.4)
Unbleached Kraft						
o Linerboard	52.6	(12.6)	0.8	(1.7)	1.3	(2.6)
o Bag	52.6	(12.6)	1.1	(2.1)	1.3	(2.6)
Semi-Chemical	43.0	(10.3)	1.3	(2.5)	1.1	(2.1)
Unbleached Kraft and Semi-Chemical	58.4	(14.0)	1.3	(2.5)	1.5	(2.9)
Dissolving Sulfite Pulp						
o Nitration	275.4	(66.0)	5.9	(11.7)	6.9	(13.8)
o Viscose	275.4	(66.0)	6.2	(12.5)	6.9	(13.8)
o Cellophane	275.4	(66.0)	6.8	(13.5)	6.9	(13.8)
o Acetate	302.1	(72.4)	9.1	(18.2)	7.5	(15.1)
Papergrade Sulfite[2]	(3)	(3)	(3)	(3)	(3)	(3)
Groundwood-Thermo-Mechanical	--	--	--	--	--	--
Groundwood-CMN Papers	99.3	(23.8)	1.6	(3.2)	2.5	(5.0)
Groundwood-Fine Papers	91.4	(21.9)	1.5	(3.0)	2.3	(4.6)
Secondary Fibers Segment						
Deink						
o Fine Papers	101.8	(24.4)	2.7	(5.4)	2.5	(5.1)
o Tissue Papers	101.8	(24.4)	2.7	(5.4)	2.5	(5.1)
o Newsprint	--	--	--	--	--	--
Tissue From Wastepaper	105.2	(25.2)	2.5	(5.0)	2.6	(5.3)
Paperboard From Wastepaper						
o Corrugating Medium Furnish	30.0	(7.2)	0.8	(1.6)	0.8	(1.5)
o Noncorrugating Medium Furnish	30.0	(7.2)	0.6	(1.2)	0.8	(1.5)
Wastepaper-Molded Products	88.1	(21.1)	1.0	(2.0)	2.2	(4.4)
Builders' Paper and Roofing Felt	60.1	(14.4)	1.5	(3.1)	1.5	(3.0)
Nonintegrated Segment						
Nonintegrated-Fine Papers						
o Wood Fiber Furnish	63.4	(15.2)	1.5	(2.9)	1.6	(3.2)
o Cotton Fiber Furnish	176.5	(42.3)	3.6	(7.2)	4.4	(8.8)
Nonintegrated-Tissue Papers	95.6	(22.9)	1.6	(3.2)	3.8	(7.5)
Nonintegrated-Lightweight Papers						
o Lightweight	203.2	(48.7)	3.5	(6.9)	8.0	(16.0)
o Electrical	320.9	(76.9)	5.5	(10.9)	12.7	(25.3)
Nonintegrated-Filter and Nonwoven Papers	250.0	(59.9)	4.2	(8.5)	9.9	(19.7)
Nonintegrated-Paperboard	53.8	(12.9)	0.9	(1.8)	2.1	(4.2)

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[1] Includes Fine Bleached Kraft and Soda subcategories.

[2] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories.

[3] BCT varies with the percent sulfite pulp in the final product. These equations can be used to obtain annual average effluent characteristics for Papergrade Sulfite mills:

$$\text{Flow (kl/kkg)} = 41.93 + 1.890x$$

$$\text{BOD}\underline{5}\text{ (kg/kkg)} = 0.0803\,(0.161x + 2.95)\,[(10.05 + 0.453x)/(0.266x + 4.45) + 1.43]$$

$$\text{TSS (kg/kkg)} = 0.1043\,(10.05 + 0.453x)$$

where x equals the percent sulfite pulp produced on-site in the final product.

BCT Option 2 annual average effluent characteristics are presented for each subcategory in Table III-35. Attainment of these levels is discussed in the next section.

OPTION 3

BCT Option 3 technology is defined as BPT technology and the application of production process controls to reduce waste effluents (BCT Option 1) plus the addition of CAC for all integrated and secondary fiber subcategories and for the nonintegrated-fine papers subcategory (subcategories for which the technology basis of BPT is biological treatment). Option 3 is based on the addition of solids-contact clarifier(s) using alum as a coagulant and polymer as a flocculant aid. For the remaining nonintegrated subcategories, for which primary treatment was the technology basis of BPT, final effluent levels are based on the application of BCT Option 1 plus the addition of biological treatment. The production process controls available for application in each subcategory for RWL reduction are presented in Tables III-1 through III-3. Annual average final effluent levels were developed as described above for BCT Option 2 using the BCT Option 1 flows and are presented in Table III-36.

Attainment of BCT Options 2 and 3

There are two mills (030034 and 080027) using full scale CAC technology in the subcategories for which CAC is the technology basis for BCT Options 2 and 3, for which BCT Options 2 and 3 effluent characteristics can be determined. As shown in Table III-37, both mills have long-term average final effluent BOD_5 and TSS effluent levels less than their respective BCT Option 2 BOD_5 and TSS effluent characteristics. One of these mills (080027) also attains BCT Option 3 BOD_5 and TSS effluent characteristics. There are no other mills employing tertiary CAC technologies for which BCT effluent levels have been developed.

The BCT Option 2 technology basis for mills in the nonintegrated-tissue papers, nonintegrated-lightweight papers, nonintegrated-filter and nonwoven papers and nonintegrated paperboard subcategories is the BPT technology basis for these subcategories plus the addition of biological treatment. The BCT Option 3 technology basis is the same as the Option 2 technology basis plus the addition of the BCT Option 1 process controls specific to these subcategories. As shown in Table III-38, each subcategory in this segment has at least one mill which now employs biological treatment. BCT Option 2 levels are attained at 19 of the 33 mills for which there are data, and BCT Option 3 is attained at 15 of the 33 mills.

OPTION 4

BCT Option 4 effluent levels are generally based on actual effluent data. This approach is in contrast to the other BCT options for which limitations are based on the predicted

TABLE III-36

BCT OPTION 3
LONG-TERM AVERAGE DISCHARGE CHARACTERISTICS

	Flow		BOD5		TSS	
	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
Integrated Segment						
Dissolving Kraft	210.7	(50.0)	4.0	(7.9)	5.2	(10.4)
Market Bleached Kraft	154.8	(37.1)	2.4	(4.8)	3.9	(7.7)
BCT Bleached Kraft	123.9	(29.7)	2.1	(4.2)	3.1	(6.2)
Alkaline-Fine[1]	99.7	(23.9)	1.5	(2.9)	2.5	(5.0)
Unbleached Kraft						
o Linerboard	40.5	(9.7)	0.7	(1.3)	1.0	(2.0)
o Bag	48.0	(11.5)	1.0	(1.9)	1.2	(2.4)
Semi-Chemical	30.5	(7.3)	0.9	(1.8)	0.8	(1.5)
Unbleached Kraft and Semi-Chemical	48.0	(11.5)	1.0	(2.1)	1.2	(2.4)
Dissolving Sulfite Pulp						
o Nitration	233.7	(56.0)	5.0[4.7]	(9.9[9.4])	5.8	(11.7)
o Viscose	233.7	(56.0)	5.3[4.7]	(10.6[9.4])	5.8	(11.7)
o Cellophane	233.7	(56.0)	5.7[5.0]	(11.5[10.0])	5.8	(11.7)
o Acetate	260.4	(62.4)	7.9[6.2]	(15.7[12.4])	6.5	(13.1)
Papergrade Sulfite[2]	(3)	(3)	(3)	(3)	(3)	(3)
Groundwood-Thermo-Mechanical	--	--	--	--	--	--
Groundwood-CMN Papers	70.1	(16.8)	1.1	(2.3)	1.8	(3.5)
Groundwood-Fine Papers	64.3	(15.4)	1.0	(2.1)	1.6	(3.2)
Secondary Fibers Segment						
Deink						
o Fine Papers	44.2	(10.6)	1.2	(2.3)	1.1	(2.2)
o Tissue Papers	52.2	(12.5)	1.4	(2.7)	1.3	(2.6)
o Newsprint	--	--	--	--	--	--
Tissue From Wastepaper	68.0	(16.3)	1.6	(3.3)	1.7	(3.4)
Paperboard From Wastepaper						
o Corrugating Medium Furnish	13.4	(3.2)	0.4	(0.7)	0.3	(0.7)
o Noncorrugating Medium Furnish	13.4	(3.2)	0.3	(0.5)	0.3	(0.7)
Wastepaper-Molded Products	23.8	(5.7)	0.3	(0.5)	0.6	(1.2)
Builders' Paper and Roofing Felt	11.3	(2.7)	0.3	(0.6)	0.3	(0.6)
Nonintegrated Segment						
Nonintegrated-Fine Papers						
o Wood Fiber Furnish	39.2	(9.4)	0.9	(1.8)	1.0	(2.0)
o Cotton Fiber Furnish	130.2	(31.2)	2.6	(5.3)	3.3	(6.5)
Nonintegrated-Tissue Papers	79.7	(19.1)	1.3	(2.6)	3.1	(6.2)
Nonintegrated-Lightweight Papers						
o Lightweight	159.4	(38.2)	2.6	(5.2)	6.2	(12.3)
o Electrical	278.8	(66.8)	4.5	(9.1)	10.8	(21.6)
Nonintegrated-Filter and Nonwoven Papers	198.2	(47.5)	3.2	(6.5)	7.7	(15.3)
Nonintegrated-Paperboard	46.7	(11.2)	0.8	(1.5)	1.8	(3.6)

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[1] Includes Fine Bleached Kraft and Soda subcategories.

[2] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories.

[3] The expected lower BOD5 discharge chracteristics for mills in this subcategory that employ MgO as a base (and for which, consequently, neutralization of spent sulfite liquor is a BCT Options 1 and 3 process control) have been conservatively set equal to the BCT Option 3 BOD5 effluent characteristics for mills that do not employ MgO.

[4] BCT varies with the percent sulfite pulp in the final product. These equations can be used to obtain annual average effluent characteristics for Papergrade Sulfite mills:

$$\begin{aligned}
\text{Flow (kl/kkg)} &= 34.64 + 1.561x \\
\text{BOD5 (kg/kkg)} &= 0.0803\,(0.161x + 2.95)\,(8.3 + 0.374x)\,[1/(0.266x + 4.45) \\
&\qquad + 1.43/(10.05 + 0.453x)] \\
\text{TSS (kg/kkg)} &= 0.1043\,(8.3 + 0.374x)
\end{aligned}$$

where x equals the percent sulfite pulp produced on-site in the final product.

TABLE III - 37

FACILITIES THAT USE TERTIARY CHEMICALLY ASSISTED CLARIFICATION AND ATTAIN BCT OPTIONS 2 AND 3 FINAL EFFLUENT CHARACTERISTICS

		Long-Term Average BOD5						Long-Term Average TSS					
		Final Effluent		BCT Option 2		BCT Option 3		Final Effluent		BCT Option 2		BCT Option 3	
Mill	Subcategory	kg/kkg	(lb/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
030034[1]	Alkaline-Fine Papers	1.01	(2.02)	1.9	(3.7)	1.4	(2.8)	2.67	(5.33)	3.0	(5.9)	2.3	(4.5)
080027	Nonintegrated-Fine Papers	0.91	(1.82)	1.5	(2.9)	0.9	(1.8)	0.66	(1.31)	1.6	(3.2)	1.0	(2.0)

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[1] BCT Options 2 and 3 final effluent characteristics are prorated.

TABLE III-38

NUMBER OF FACILITIES IN SUBCATEGORIES FOR WHICH PRIMARY TREATMENT IS THE TECHNOLOGY BASIS OF BPT THAT ATTAIN BPT AND BCT OPTION 3 FINAL EFFLUENT CHARACTERISTICS

Subcategory	Mills with Available Data	Mills with Biological Treatment Systems	Mills Attaining BPT F.E. Levels(a)	Mills Attaining BCT Option 2 F.E. Levels(a)	Mills Attaining BCT Option 3 F.E. Levels (a)
Nonintegrated-Tissue Papers	14	3	9	5	4
Nonintegrated-Lightweight Papers					
o Lightweight	7	3	6	6	5
o Electrical	2	1	2	2	1
Nonintegrated-Filter and Nonwoven Papers	4	3	4	4	3
Nonintegrated-Paperboard	6	2	2	2	2
Total	33	12	23	19	15

(a) F.E. = Final Effluent

performance of specific technologies.

EPA has generally defined BCT Option 4 to include the application of additional end-of-pipe treatment to BPT RWLs. The BCT Option 4 methodology, as discussed below, differs for the paperboard from wastepaper, tissue from wastepaper, wastepaper-molded products, and builders' paper and roofing felt subcategories. Except for these four subcategories, the BCT Option 4 RWLs are identical to the BPT RWLs and are presented in Table III-39. Because sufficient data are not available to establish pollutant removals and associated costs of removal, BCT Option 4 has been reserved for the groundwood TMP subcategory and the newsprint sector of the deink subcategory.

After the BCT Option 4 effluent levels were determined, the Agency identified appropriate technologies that could achieve them. The technologies for achieving Option 4 effluent levels vary depending on the type of treatment systems that are used at mills in each subcategory. Treatment systems commonly used at mills in the integrated segment, the nonintegrated-fine papers subcategory, and the fine and tissue papers sectors of the deink subcategory (where BPT has been identified as biological treatment) include aerated stabilization basin (ASB) systems, activated sludge systems, and oxidation ponds. Design characteristics for the various treatment types were reviewed and compared with those of best performers. Based on this review, feasible upgrade schemes for each treatment type have been identified and used in the development of cost estimates presented in Section IV. Brief descriptions of the upgrade schemes that are the basis of cost estimates are presented below.

ASB treatment systems can be upgraded through the addition of spill prevention and control systems, by increasing aeration capacity, and by providing additional settling capacity. ASB systems located in colder climates can be converted to the extended aeration activated sludge process.

Activated sludge systems can be upgraded through the addition of spill prevention and control systems, by providing equalization, by increasing the capacity of aeration basins (providing for operation in the contact stabilization mode), and by increasing the size of clarification and sludge handling equipment.

Oxidation ponds are upgraded through the addition of rapid sand filtration to remove algae that can contribute to the discharge of high levels of suspended solids.

At mills in the nonintegrated subcategories (except for the nonintegrated-fine papers subcategory), where BPT effluent limitations are based on primary treatment, the technology basis of BCT Option 4 is primary clarification. Design criteria were established that reflect attainment of BCT Option 4 effluent levels by treating the BPT RWLs for these subcategories with end-of-pipe treatment. The primary clarification system includes chemical coagulant addition and additional sludge handling

TABLE III-39

BCT OPTION 4
LONG-TERM AVERAGE RAW WASTE LOADS

	Flow		BOD5		TSS	
	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
Integrated Segment						
Dissolving Kraft	229.9	(55.1)	66.5	(133.0)	113.0	(226.0)
Market Bleached Kraft	173.6	(41.6)	38.0	(75.9)	45.0	(90.0)
BCT Bleached Kraft	147.7	(35.4)	38.4	(76.7)	66.5	(133.0)
Alkaline-Fine[1]	128.9	(30.9)	33.6	(67.2)	75.0	(150.0)
Unbleached Kraft						
o Linerboard	52.6	(12.6)	16.9	(33.8)	21.9	(43.8)
o Bag	52.6	(12.6)	23.7	(47.4)	21.9	(43.8)
Semi-Chemical	43.0	(10.3)	25.2	(50.4)	12.3	(24.6)
Unbleached Kraft and Semi-Chemical	58.4	(14.0)	19.4	(38.8)	20.5	(41.0)
Dissolving Sulfite Pulp						
o Nitration	275.4	(66.0)	137.0	(274.0)	92.5	(185.0)
o Viscose	275.4	(66.0)	156.0	(312.0)	92.5	(185.0)
o Cellophane	275.4	(66.0)	181.5	(363.0)	92.5	(185.0)
o Acetate	302.1	(72.4)	266.4	(532.8)	92.5	(185.0)
Papergrade Sulfite[2]	185.6-227.3	(44.5-54.5)	84-139.5	(168-279)	90.0	(180.0)
Groundwood-Thermo-Mechanical	--	--	--	--	--	--
Groundwood-CMN Papers	99.3	(23.8)	17.4	(34.8)	48.5	(97.0)
Groundwood-Fine Papers	91.4	(21.9)	16.7	(33.3)	52.5	(105.0)
Secondary Fibers Segment						
Deink						
o Fine Papers	101.8	(24.4)	90.0	(180.0)	202.5	(405.0)
o Tissue Papers	101.8	(24.4)	90.0	(180.0)	202.5	(405.0)
o Newsprint	--	--	--	--	--	--
Tissue From Wastepaper	68.0	(16.3)	9.7	(19.3)	110.5	(221.0)
Paperboard From Wastepaper						
o Corrugating Medium Furnish	13.4	(3.2)	23.0	(46.0)	11.0	(21.9)
o Noncorrugating Medium Furnish	13.4	(3.2)	11.3	(22.5)	11.0	(21.9)
Wastepaper-Molded Products	23.8	(5.7)	5.5	(10.9)	14.8	(29.6)
Builders' Paper and Roofing Felt	11.3	(2.7)	7.4	(14.8)	35.0	(70.0)
Nonintegrated Segment						
Nonintegrated-Fine Papers						
o Wood Fiber Furnish	63.4	(15.2)	10.8	(21.5)	30.8	(61.6)
o Cotton Fiber Furnish	176.5	(42.3)	22.9	(45.8)	55.2	(110.4)
Nonintegrated-Tissue Papers	95.6	(22.9)	11.5	(22.9)	34.7	(69.4)
Nonintegrated-Lightweight Papers						
o Lightweight	203.2	(48.7)	21.7	(43.3)	63.4	(126.8)
o Electrical	320.9	(76.9)	21.7	(43.3)	63.4	(126.8)
Nonintegrated-Filter and Nonwoven Papers	250.0	(59.9)	12.2	(24.3)	27.4	(54.7)
Nonintegrated-Paperboard	53.8	(12.9)	10.4	(20.8)	36.9	(73.7)

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[1] Includes Fine Bleached Kraft and Soda subcategories.

[2] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories.

capability.

At the mills in the remaining subcategories (paperboard from wastepaper, tissue from wastepaper, wastepaper-molded products, and builders' paper and roofing felt), extensive use is made of production process controls to reduce wastewater discharge. BCT Option 4 for these subcategories includes the application of production process controls and the biological treatment systems which formed the basis of BPT. Option 4 is identical to BCT Option 1, and the end-of-pipe biological treatment systems are the same as those which form the basis of BPT effluent limitations for these subcategories. Therefore, BCT Option 1 and 4 final effluent loads are lower than BPT effluent limitations because after implementation of flow and BOD_5 RWL reducing in-plant production process controls, the detention time of the biological treatment system has been increased and the effective BOD_5 and TSS influent loads are reduced.

To determine the effluent levels and appropriate technologies of BCT Option 4, "best performing" mills were identified; attainable pollutant reductions were determined through a review of discharge monitoring reports (DMR) and long-term conventional pollutant data from the industry. This information was obtained as a result of the verification and supplemental data request programs and the subsequent data requests associated with the 1981 proposal and the 1982 promulgation of the pulp, paper, and paperboard industry regulations. These data are summarized in Tables III-36 through III-57.

The final effluent levels characteristic of the best performing mills in a subcategory form the basis of BCT Option 4 BOD_5 and TSS discharge characteristics for that subcategory. EPA has generally defined best performing mills as mills where 1) both the long-term average BOD_5 and TSS effluent loads are equal to or less than the long-term average BOD_5 and TSS BPT effluent levels and 2) the end-of-pipe technology is of a type similar to that which forms the basis of BPT. Generally, long-term average final effluent BOD_5 and TSS discharges per kkg (ton) of product attained at best performing mills were averaged; corresponding concentrations of BOD_5 were then determined at BPT flow. In cases where BCT Option 4 long-term average BOD_5 effluent concentrations corresponding to BPT flow were less than 15 mg/l, the long-term average BOD_5 concentration was revised upward to 15 mg/l. The Agency believes that 15 mg/l is a realistic estimate of the lowest attainable long-term average BOD_5 concentration that biological treatment can achieve in treating pulp, paper, and paperboard industry wastewaters.

The methodology to determine BCT Option 4 BOD_5 and TSS final effluent characteristics was modified slightly for mills in the dissolving kraft, alkaline-fine papers (including the fine bleached kraft and soda subcategories), papergrade sulfite (drum wash and blow pit) subcategories, and the fine papers and tissue papers sectors of the deink subcategory. BPT effluent limitations for these subcategories were based on data representative of facilities that only manufacture products characteristic of each specific subcategory. However, many mills in these subcategories manufacture some products typical of other subcategories. BPT raw waste loads and final effluent characteristics for mills of this type can be determined by multiplying the guidelines for each appropriate subcategory by the quantity of product produced at the mill typical of that subcategory, and then summing over all subcategories. BPT effluent characteristics or RWLs determined by this method are referred to as prorated BPT effluent characteristics or prorated BPT RWLs. BCT Option 4 BOD5 and TSS long-term final effluent characteristics for each of these subcategories were determined by calculating the prorated BPT BOD5 and TSS final effluent characteristics for each mill. The facilities were identified that attained both BOD5 and TSS final effluent levels lower than their respective prorated BPT BOD5 and TSS effluent characteristics. The percent reduction of final effluent long-term average BOD5 below prorated BPT BOD5 was determined for each best performer as follows:

$$\text{percent reduction} = 100 \times \frac{(\text{prorated BPT FE BOD5} - \text{FE BOD5})}{\text{prorated BPT FE BOD5}},$$

where FE = final effluent.

The percent reductions of BOD5 for all best performers in the subcategory were averaged. The subcategory BCT Option 4 final effluent BOD5 was then found by decreasing the subcategory BPT final effluent BOD5 by the average percent reduction characteristic of the subcategory, as follows:

$$\text{BCT Option 4 FE BOD5} = \text{BPT FE BOD5} \times \left(1 - \frac{\text{average percent reduction}}{100}\right)$$

The same procedure was followed to determine the BCT Option 4 final effluent TSS levels. BCT Option 4 flow is equal to BPT flow.

The subcategory BCT Option 4 final effluent BOD5 and TSS characteristics, as determined above, are representative of mills which manufacture only products typical of their subcategory and do not require proration.

A description of the specific procedure used to establish BCT Option 4 effluent characteristics for each subcategory follows. In some instances, EPA slightly modified the approach in determining "best performers."

Dissolving Kraft - The dissolving kraft subcategory is comprised of three mills, all of which produce dissolving kraft pulp and 28 to 51 percent bleached kraft market pulp (see Table III-40). Table III-40 presents available final effluent long-term average

TABLE III-40
DISCHARGE MONITORING REPORT DATA
DISSOLVING KRAFT SUBCATEGORY

	Final Effluent Flow		Final Effluent BOD5					Final Effluent TSS						Number of Months Data		
Mill Number	Long Term Average kl/kkg	Long Term Average (kgal/t)	Prorated BPT(a) kg/kkg	Prorated BPT(a) (lb/t)	Long Term Average kg/kkg	Long Term Average (lb/t)	% Less than Prorated BPT(b)	Prorated BPT(a) kg/kkg	Prorated BPT(a) (lb/t)	Long Term Average kg/kkg	Long Term Average (lb/t)	% Less than Prorated BPT(b)	Start Date	Flow	BOD5	TSS
032001	124.9	(29.94)	6.2	(12.3)	5.5	(10.92)		10.4	(20.8)	19.4	(38.81)		12/79	13	13	13
032002(c)	186.7	(44.74)	5.6	(11.2)	3.7	(7.47)	33.3	9.9	(19.8)	5.9	(11.71)	40.9	07/77	45	45	45
032003	248.2	(59.48)	5.9	(11.8)	5.9	(11.80)		10.2	(20.4)	10.5	(20.95)		01/78	38	38	38
BPT-Final Effluent Levels	230.0	(55.1)			6.9	(13.8)				11.1	(22.1)					
Average % less than BPT for Mills Attaining BPT BOD5 & TSS							33.3					40.9				
BPT x (100-Ave % less)/100					4.60	(9.20)				6.53	(13.06)					

(a) Prorated BPT is based on precentage of different products manufactured at each mill. Prorated BPT (for flow/BOD5/TSS) = (BPT for dissolving kraft pulp) x (% dissolving kraft pulp) + (BPT for marked bleached kraft) x (% market bleached kraft pulp).

(b) Percent less than prorated BPT = 100 x (prorated BPT - long-term average)/prorated BPT.

(c) TSS and BOD5 are less than or equal to prorated BPT effluent limitations.

data. BPT final effluent limits for this subcategory are representative of mills which manufacture 100 percent dissolving kraft pulp. Thus, it is necessary to prorate BPT effluent levels for these mills between dissolving kraft and market bleached kraft BPT effluent levels.

Since BPT levels for mills in this subcategory are determined by proration, the modified methodology, as described above, was used to develop BCT Option 4 BOD5 and TSS effluent levels. Prorated BPT BOD5 and TSS limitations were calculated for each mill, and are presented in Table III-40. Prorated BPT effluent limitations are being attained at mill 032002. BOD5 and TSS effluent levels at this mill are 33.3 percent and 40.9 percent less than prorated BPT BOD5 and TSS effluent levels, respectively. Therefore, BCT Option 4 effluent levels (representative of mills which produce 100 percent dissolving kraft pulp) are 33.3 percent and 40.9 percent less than the BPT BOD5 and TSS effluent levels, respectively, for the dissolving kraft subcategory. BCT Option 4 flow and final effluent BOD5 and TSS levels for the dissolving kraft subcategory are 229.9 kl/kkg (55.1 kgal/t), 4.6 kg/kkg (9.2 lb/t) and 6.5 kg/kkg (13.1 lb/t), respectively.

Market Bleached Kraft - As illustrated in Table III-41, the general methodology was used to calculate BCT Option 4 effluent levels for the market bleached kraft subcategory. Mills 030028, 030030, 030031, 666666, 777777, and 900074 are best performers in this subcategory and were used to determine long-term average final effluent levels. In addition to these mills, the integrated-miscellaneous group mill 030011 was included in the calculation. At this mill, where prorated BPT effluent levels are being attained, bleached kraft pulp is produced, a significant portion of which is market pulp. The approach used to include data for this mill involved comparing BOD5 and TSS effluent levels to BPT effluent levels determined by prorating effluent levels from appropriate subcategories. The percentage reductions attained at mill 030011 were then applied to market bleached kraft BPT effluent levels. BOD5 and TSS effluent levels for mill 030011 are 19.5 percent and 59.2 percent below prorated BPT effluent levels. Using characteristics from the seven "best performing mills", the resulting BCT Option 4 flow and final effluent BOD5 and TSS levels for the market bleached kraft subcategory are 173.6 kl/kkg (41.6 kgal/t), 3.3 kg/kkg (6.6 lb/t) and 5.7 kg/kkg (11.4 lb/t), respectively.

BCT (Paperboard, Coarse, and Tissue) Bleached Kraft - As illustrated in Table III-42, the general methodology was used to calculate BCT Option 4 effluent characteristics for the BCT bleached kraft subcategory. Mills 030010, 030022, 030032 are best performers and were used to determine long-term average final effluent levels. In addition to these mills, mills 030036 and 030044 were included in the calculation. At these integrated-miscellaneous group mills where BPT effluent levels are being attained, bleached kraft pulp is produced, a significant portion of which is used to manufacture paperboard, coarse papers, or tissue papers. The approach used to include

TABLE III-41
DISCHARGE MONITORING REPORT DATA
MARKET BLEACHED KRAFT SUBCATEGORY

Mill Number	Final Effluent Long-Term Average Levels Flow kl/kkg (kgal/t)	 BOD5 kg/kkg (lb/t)	 TSS kg/kkg (lb/t)	Start Date	Number Of Months Data Flow	 BOD5	 TSS
030005	61.3 (14.68)	4.8 (9.65)	5.0 (9.97)	08/78	29	29	29
030009	76.4 (18.32)	6.2 (12.40)	4.8 (9.66)	01/78	39	39	39
030012	119.0 (28.52)	5.8 (11.60)	19.5 (39.03)	01/78	36	36	36
030028(a)	142.6 (34.18)	4.3 (8.55)	7.8 (15.65)	08/78	31	31	31
030030(a)	151.8 (36.38)	2.7 (5.41)	3.7 (7.37)	01/78	38	38	38
030031(a)	281.8 (67.53)	4.5 (8.94)	9.0 (18.03)	07/77	33	43	43
666666(a)	85.9 (20.59)	2.6 (5.16)	6.8 (13.57)	02/79	23	23	23
777777(a)	135.5 (32.46)	1.5 (3.08)	6.5 (12.98)	07/79	16	16	16
900074(a)	121.6 (29.13)	4.0 (7.94)	2.6 (5.16)	09/78	31	31	31
030011(a)(b)	140.4 (33.65)	3.6 (7.25)	3.7 (7.34)	08/78	21	21	21
BPT-Final Effluent Levels	173.0 (41.6)	4.5 (9.0)	9.0 (18.0)				
Average of Mills Attaining BPT BOD5 and TSS		3.3 (6.62)	5.7 (11.44)				

(a) TSS and BOD5 are less than or equal to BPT.

(b) This mill is an integrated miscellaneous mill where market bleached kraft comprises approximately 40 percent of the production. Prorated BPT was determined for this mill. The percent effluent BOD5 and TSS reductions being attained were then applied to BPT BOD5 and TSS effluent levels for the subcategory to obtain the effluent levels shown.

TABLE III-42
DISCHARGE MONITORING REPORT DATA
BCT BLEACHED KRAFT SUBCATEGORY

Mill Number	Final Effluent Long-Term Average Levels			Start Date	Number Of Months Data		
	Flow kl/kkg (kgal/t)	BOD5 kg/kkg (lb/t)	TSS kg/kkg (lb/t)		Flow	BOD5	TSS
030004	208.0 (49.84)	4.6 (9.18)	4.2 (8.49)	10/78	28	28	28
030010(a)	170.9 (40.95)	2.5 (4.92)	4.3 (8.69)	07/77	43	43	43
030022(a)	150.0 (35.94)	3.9 (7.81)	1.8 (3.54)	01/78	39	39	39
030026	136.0 (32.59)	4.9 (9.73)	8.6 (17.25)	07/77	42	44	41
030032(a)	106.8 (25.60)	2.5 (5.09)	4.5 (8.95)	01/78	38	38	38
030047	151.7 (36.35)	5.4 (10.73)	4.3 (8.56)	10/78	25	25	25
900010	121.1 (29.02)	4.5 (9.03)	4.5 (9.03)	06/78	31	31	31
030036(a)(b)	129.8 (31.11)	2.7 (5.43)	6.8 (13.53)	07/77	33	33	33
030044(a)(b)	117.3 (28.12)	1.3 (2.56)	4.3 (8.50)	05/78	34	34	34
BPT-Final Effluent Levels	148.0 (35.4)	4.0 (8.0)	7.1 (14.2)				
Average of Mills Attaining BPT BOD5 and TSS		2.6 (5.16)	4.3 (8.64)				

(a) TSS and BOD5 are less than or equal to BPT.

(b) Mills are integrated miscellaneous mills where BCT bleached kraft comprise approximately 80 and 50 percent of the production, respectively. Prorated BPT was determined The percent effluent BOD5 and TSS reductions being attained were then applied to BPT BOD5 and TSS effluent levels for the subcategory to obtain the effluent levels shown.

data for these mills involved comparing BOD5 and TSS effluent levels to BPT effluent levels determined by prorating effluent levels from appropriate subcategories. The percentage reductions attained at these two mills were then applied to the BCT bleached kraft BPT limitations. Effluent BOD5 and TSS characteristics for mill 030036 are 32.2 and 4.7 percent below prorated BPT limitations, and effluent characteristics for mill 030044 are 68.0 and 40.1 percent below prorated BPT effluent levels. The resulting BCT Option 4 flow and final effluent BOD5 and TSS levels for the BCT bleached kraft subcategory are 147.7 kl/kkg (35.4 kgal/t), 2.6 kg/kkg (5.2 lb/t) and 4.3 kg/kkg (8.6 lb/t), respectively.

Alkaline-Fine (Fine Bleached Kraft and Soda Subcategories) - Mills in the alkaline-fine paper subcategory manufacture fine papers and often a small amount of market bleached kraft pulp, primarily from a furnish consisting of bleached kraft (or soda) pulp and frequently some purchased pulp. Four mills in this subcategory also manufacture small amounts of groundwood pulp which is combined with alkaline pulp to produce groundwood-fine papers.

BPT final effluent levels for this subcategory are representative of mills which manufacture only fine papers from alkaline or soda pulp, 100 percent of which is manufactured on-site. Thus, it is necessary to prorate BPT effluent levels for mills in this subcategory between effluent levels for alkaline fine papers and other appropriate subcategories including market bleached kraft, groundwood-fine papers, and nonintegrated-fine papers.

Since BPT effluent levels for mills in this subcategory are determined by proration, the modified methodology described above was used to develop BCT Option 4 BOD5 and TSS effluent levels. Prorated BPT levels were calculated for each mill and are presented with available long-term average effluent wastewater data in Table III-43. Prorated BPT effluent levels for BOD5 and TSS are being attained at mills 030020, 030027, 030034, 030046, and 030052. Mill 030034, which employs tertiary chemically assisted clarification, is not included in the averages since this technology is not considered similar to the BPT technology basis.

However, mills 030011 and 030044 were included in the calculations. At these integrated-miscellaneous group mills, where prorated BPT levels are being attained, bleached kraft pulp is produced, a significant portion of which is used to produce fine papers.

The percent reduction in BOD5 and TSS below prorated BPT BOD5 and TSS effluent levels for each of these mills is presented in Table III-43. The average of the percent reductions below prorated BPT effluent levels are 42.8 percent and 51.0 percent, respectively for BOD5 and TSS. Thus, BCT Option 4 effluent levels (representative of mills which produce only fine papers from alkaline or soda pulp produced on-site) for BOD5 and TSS are 42.8

and 51.0 percent less than BPT long-term average effluent levels for the alkaline-fine papers grouping of subcategories. The BCT Option 4 TSS final effluent level is shown in Table III-43. However, upon calculation of the concentration of BOD5 corresponding to the BPT flow for the fine bleached kraft subcategory, EPA determined that the resulting BOD5 effluent concentration was below 15 mg/l. Thus, the BCT Option 4 BOD5 effluent concentration was set equal to 15 mg/l and the effluent level was revised correspondingly. The resulting Option 4 BOD5 effluent characteristic is shown in Table III-43. BCT Option 4 flow and final effluent BOD5 and TSS levels for the alkaline-fine papers subcategory are 128.9 kl/kkg (30.9 kgal/t), 1.9 kg/kkg (3.9 lb/t) and 3.2 kg/kkg (6.4 lb/t), respectively.

Unbleached Kraft - As discussed previously, EPA has established two sectors of this subcategory: (a) the linerboard sector and (b) the bag and other products sector. EPA's review of the BPT final effluent levels for the unbleached kraft subcategory indicate that the BPT final effluent BOD5 concentration is considerably higher for the linerboard sector than for other subcategories with comparable raw waste BOD5 and underestimates the pollutant reduction capability in this sector. Therefore, to determine a more realistic set of best performing mills in the linerboard sector the BPT final effluent BOD5 concentration was revised downward using the BPT raw waste BOD5 concentration and the relationship between BOD5 influent concentration and effluent concentration presented here previously and in the December 1976 development document supporting the January 1977 Phase II BPT regulations (see reference 9, page 402). Using this methdology, the adjusted final effluent BOD5 long-term average comparison level is 1.6 kg/kkg (3.2 lb/t).

The general methodology was then followed for the linerboard sector using the comparison level BOD5 as illustrated in Table III-44. The comparison level final effluent BOD5 and BPT final effluent TSS levels for mills in this sector are attained at mills 010002, 010019, 010020, 010025, 010040, and 010046. Data for mills with oxidation ponds (010020, 010025, and 010046) were excluded from the calculation. Mill 010008 was included in the calculation. Substantial quantities of both linerboard and bag and other products are manufactured at this mill where prorated comparison level final effluent BOD5 and BPT final effluent TSS levels (the same for both sectors) are being attained. The approach used to include data for mill 010008 involved comparing the mill's BOD5 effluent loading to the comparison level determined by prorating the BOD5 comparison levels for the two sectors. The percent reduction below the prorated comparison level (40.1 percent) was then applied to the comparison level for the linerboard sector to obtain the long-term average final effluent BOD5 level shown with the linerboard data [0.97 kg/kkg (1.93 lb/t)]. No adjustment to the final effluent TSS was required because the TSS comparison levels are equal to BPT final effluent TSS levels and are the same for both sectors.

TABLE III-43
DISCHARGE MONITORING REPORT DATA
ALKALINE-FINE[1]

Mill Number	Final Effluent Flow		Final Effluent BOD5					Final Effluent TSS					Start Date	Number of Months Data		
	Long-Term Average kl/kkg	Long-Term Average (kgal/t)	Prorated BPT(a) kg/kkg	Prorated BPT(a) (lb/t)	Long-Term Average kg/kkg	Long-Term Average (lb/t)	% Less than Prorated BPT(b)	Prorated BPT(a) kg/kkg	Prorated BPT(a) (lb/t)	Long-Term Average kg/kkg	Long-Term Average (lb/t)	% Less than Prorated BPT(b)		Flow	BOD5	TSS
030001	107.2	(25.69)	3.0	(5.9)	2.7	(5.47)		5.9	(11.8)	10.9	(21.82)		11/78	26	27	27
030013	138.4	(33.17)	2.8	(5.6)	2.7	(5.36)		5.3	(10.5)	8.5	(17.08)		01/78	27	35	34
030020(c)	112.3	(26.92)	2.9	(5.7)	1.3	(2.65)	53.5	5.2	(10.3)	2.5	(5.03)	51.2	12/78	24	24	24
030027(c)	63.4	(15.20)	3.0	(6.0)	0.7	(1.34)	77.7	6.1	(12.2)	2.1	(4.20)	65.6	04/78	33	33	33
030033	147.1	(35.24)	3.7	(7.3)	6.8	(13.68)		7.0	(14.0)	21.4	(42.73)		01/78	35	35	35
030034(c)(d)	69.6	(16.67)	3.0	(6.0)	1.0	(2.02)		6.0	(12.0)	2.7	(5.33)		10/79	18	18	18
030046(c)	137.6	(32.97)	3.2	(6.4)	2.1	(4.13)	35.5	6.7	(13.4)	3.1	(6.29)	53.1	07/77	27	27	27
030048	110.3	(26.44)	4.8	(9.6)	5.7	(11.48)		9.1	(18.1)	13.4	(26.89)		01/78	36	36	36
030052(c)	127.7	(30.59)	3.2	(6.4)	3.1	(6.16)	3.8	6.5	(12.9)	3.8	(7.58)	41.2	01/80	12	12	12
030057	114.2	(27.37)	2.8	(5.6)	7.1	(14.24)		5.2	(10.3)	5.8	(11.55)		07/77	44	43	43
030058	124.0	(29.72)	3.9	(7.8)	4.1	(8.23)		7.5	(14.9)	7.4	(14.76)		07/77	33	33	33
030059	143.4	(34.37)	2.8	(5.5)	2.7	(5.31)		5.0	(10.0)	11.2	(22.34)		05/78	36	36	36
130060	247.5	(59.32)	2.8	(5.6)	31.8	(63.60)		5.4	(10.8)	25.1	(50.28)		02/78	33	32	33
130002	70.1	(16.81)	2.8	(5.6)	2.3	(4.56)		5.2	(10.4)	8.5	(17.00)		07/78	18	18	18
030011(c)(e)	140.4	(33.66)	3.7	(7.3)	2.9	(5.87)	19.6	7.5	(14.9)	3.1	(6.12)	58.9	08/78	21	21	21
030044(c)(e)	117.3	(28.12)	3.5	(7.0)	1.2	(2.34)	66.6	6.6	(13.1)	4.2	(8.36)	36.2	05/78	34	34	34
Average % Less Than Prorated BPT for Mills Attaining Prorated BPT BOD5 and TSS							42.8					51.0				
BPT-Final Effluent Levels	129.0	(30.9)			3.1	(6.2)				6.6	(13.1)					
BPT x (100-% Ave less)/100					1.8	(3.55)				3.2	(6.42)					
Option 1 Adjusted BOD5					1.9	(3.87)										

(a) Prorated BPT is based on precentage of different products manufactured at each mill. Prorated BPT (for flow/BOD5/TSS) = (BPT for akaline fine papers) x (% akaline fine papers) + (BPT for market bleached kraft) x (% market bleached kraft) + similar adjustments for other appropriate subcategories.

(b) Percent less than prorated BPT = 100 x (prorated BPT - long-term average)/prorated BPT.

(c) TSS and BOD5 are less than or equal to prorated BPT effluent levels.

(d) Data are not included in the average because this mill employs tertiary chemically assisted clarification.

(e) Mills are integrated miscellaneous mills where fine papers comprise approximately 60 and 40 percent of the production at mills 030011 and 030044, respectively.

[1] Includes Fine Bleached Kraft and Soda subcategories.

TABLE III-44
DISCHARGE MONITORING REPORT DATA
UNBLEACHED KRAFT SUBCATEGORY

Mill Number	Final Effluent Long-Term Average Levels: Flow kl/kkg (kgal/t)	BOD5 kg/kkg (lb/t)	TSS kg/kkg (lb/t)	Start Date	Number Of Months Data: Flow	BOD5	TSS
Linerboard							
010001	46.4 (11.12)	1.8 (3.50)	3.1 (6.14)	01/78	36	36	36
010002(a)	52.7 (12.64)	1.4 (2.88)	2.7 (5.44)	07/78	33	33	33
010018	54.8 (13.13)	3.1 (6.13)	3.5 (6.97)	10/78	11	11	11
010019(a)	49.8 (11.93)	1.1 (2.29)	2.7 (5.47)	09/77	36	36	36
010020(a)(b)	81.0 (19.41)	1.1 (2.21)	1.0 (1.99)	09/78	13	13	13
010025(a)(b)	43.0 (10.31)	0.5 (1.06)	0.6 (1.11)	09/78	31	31	31
010034	84.8 (20.31)	2.3 (4.64)	3.4 (6.71)	01/78	37	37	37
010038	111.3 (26.66)	3.6 (7.21)	6.0 (11.98)	01/78	40	40	40
010040(a)	62.3 (14.93)	1.3 (2.54)	1.1 (2.20)	10/78	25	25	25
010043	42.6 (10.20)	0.7 (1.33)	5.0 (9.91)	06/79	20	22	22
010046(a)(b)	33.3 (7.97)	1.3 (2.65)	0.8 (1.69)	07/77	29	36	35
010047	22.0 (5.28)	1.9 (3.73)	0.9 (1.81)	07/77	38	38	38
010057	42.9 (10.27)	4.2 (8.46)	2.6 (5.24)	07/77	36	35	35
010063	29.3 (7.03)	2.6 (5.23)	5.3 (10.54)	06/78	34	34	34
010064	21.7 (5.19)	1.8 (3.54)	3.0 (6.02)	01/78	35	38	38
010008(a)(c)	43.3 (10.37)	1.0 (1.93)	2.5 (4.93)	06/80	46	46	46
BPT-Final Effluent Levels	52.5 (12.6)	1.9 (3.7)	3.6 (7.2)				
BOD5 Comparison Level		1.6 (3.2)					
Average of Mills Attaining BPT TSS and BOD5 Comparison Level		1.2 (2.41)	2.3 (4.51)				

TABLE III-44 (continued)
DISCHARGE MONITORING REPORT DATA
UNBLEACHED KRAFT SUBCATEGORY

Mill Number	Final Effluent Long-Term Average Levels Flow kl/kkg (kgal/t)	BOD5 kg/kkg (lb/t)	TSS kg/kkg (lb/t)	Start Date	Number Of Months Data Flow	BOD5	TSS
Bag Paper and Other Mixed Products							
010003	52.4 (12.56)	2.0 (4.01)	4.4 (8.77)	12/78	25	25	25
010028	148.6 (35.61)	1.9 (3.83)	3.8 (7.50)	03/79	23	23	23
010032	61.5 (14.74)	2.5 (4.99)	2.2 (4.30)	01/78	06	32	32
010033(a)(b)	68.1 (16.32)	1.9 (3.83)	0.4 (0.77)	07/77	29	29	29
010055(a)	43.8 (10.49)	1.9 (3.79)	2.9 (5.77)	06/80	46	46	46
010062	136.0 (32.60)	2.5 (4.92)	3.8 (7.67)	07/77	45	45	45
010008(a)(c)	148.6 (35.61)	1.2 (2.37)	2.5 (4.93)	07/77	23	39	39
BPT-Final Effluent Levels	52.5 (12.6)	1.9 (3.7)	3.6 (7.2)				
BOD5 Comparison Level		2.0 (4.0)					
Average of Mills Attaining BPT TSS and BOD5 comparison level		1.5 (3.08)	2.7 (5.35)				
Mixed Products (≥10% Linerboard and ≥10% Bag and Other Products							
010005	64.1 (15.35)	2.1 (4.20)	3.3 (6.51)	06/79	22	22	22
010006	54.5 (13.07)	2.0 (3.98)	3.0 (5.95)	07/77	42	42	42
010008	43.3 (10.37)	1.0 (2.02)	2.5 (4.93)	07/77	23	39	39
010034	84.8 (20.31)	2.3 (4.64)	3.4 (6.71)	01/78	37	37	37
010044	57.5 (13.78)	1.6 (3.19)	5.4 (10.88)	09/78	24	24	24

(a) TSS is less than or equal to BPT; BOD5 is less than or equal to the BOD5 Comparison Level.

(b) Data are not included in the averages because treatment includes an oxidation pond.

(c) This mill is a best performer and has been included in both the linerboard and the bag and other product sectors as it manufacturers 78.3% linerboard and 21.7% other products. The BOD5 comparison levels were prorated between the two product sectors (TSS is the same for both product sectors). The percent effluent BOD5 reduction below prorated comparison level BOD5 was applied to the BOD5 comparison level of each product sector to obtain the effluent BOD5 levels shown.

As discussed previously in this section, BOD5 RWLs for bag and other products mills are substantially higher than the BPT BOD5 RWL. To determine a more realistic set of best performing mills for this sector, EPA revised the BPT final effluent BOD5 level based on the relationship between BOD5 influent concentration and effluent concentration presented here previously and in the development document supporting the January 1977 Phase II regulations (see reference 9, page 402). EPA used the sector average BOD5 RWL, 23.7 kg/kkg (47.4 lb/t) (see Table III-10), as the basis for this calculation. Using this methodology, the comparison level final effluent long-term average BOD5 was adjusted upward to 2.0 kg/kkg (4.0 lb/t).

The general methodology was followed for the bag and other products sector using the comparison level BOD5 as illustrated in Table III-44. The revised comparison level final effluent BOD5 and the BPT final effluent TSS level for mills in this sector are attained at mills 010033 and 010055. Data for mill 010033 have been excluded from the calculation because the mill uses an oxidation pond which is not considered a BPT technology. Mill 010008 was included in the calculation because substantial quantities of both linerboard and bag and other products are manufactured at this mill and prorated final effluent comparison level BOD5 and BPT final effluent TSS (the same for both sectors) are being attained. To include data for this mill, EPA compared the final effluent BOD5 level to the comparison level determined by prorating the BOD5 comparison levels of the two sectors. The percent reduction below the prorated comparison level (40.1 percent) was then applied to the comparison level for the bag and other products sector to obtain the long-term average final effluent BOD5 level shown with the bag and other product data, [1.2 kg/kkg (2.37 lb/t)]. No adjustment to the final effluent TSS was required because the TSS comparison levels equal the BPT final effluent TSS levels and are the same for both sectors. BCT Option 4 flow and final effluent BOD5 and TSS levels for the linerboard sector of the unbleached kraft subcategory are 52.6 kl/kkg (12.6 kgal/t), 1.2 kg/kkg (2.4 lb/t) and 2.3 kg/kkg (4.5 lb/t) respectively, and 52.6 kl/kkg (12.6 kgal/t), 1.5 kg/kkg (3.1 lb/t) and 2.7 kg/kkg (5.4 lb/t) for the bag and other products sector.

Semi-Chemical - A review of the BPT final effluent levels for the semi-chemical subcategory indicated that the BPT final effluent BOD5 concentration is considerably higher than for other subcategories with comparable raw waste BOD5 and underestimates the pollutant reduction capability in this subcategory. Therefore, to determine a more realistic set of best performing mills, the BPT final effluent BOD5 level was revised downward based on the relationship between BOD5 influent concentration and effluent concentration presented here previously and in the development document supporting the January 1977 BPT regulations (see reference 9, page 402). Using this methodology, the adjusted long-term average comparison level final effluent BOD5 is 1.9 kg/kkg (3.8 lb/t).

The general methodology was applied using the comparison level BOD5 as illustrated in Table III-45. The revised comparison level final effluent BOD5 and BPT final effluent TSS level are attained at mills 060004, 020003, and 020009. In addition to these mills, data from a joint treatment system (treating effluent from mills 020011 and 110068) were included in the calculation. A significant portion of the wastewater discharged to the joint treatment system is associated with the production of semi-chemical pulp. The approach used to include data for this joint treatment system involved comparing BOD5 and TSS final effluent levels to BPT levels (determined by prorating BPT levels from appropriate subcategories). The percentage reductions below prorated BPT levels attained at this treatment system were then applied to the semi-chemical comparison level BOD5 and BPT TSS final effluent level to obtain the effluent BOD5 and TSS final effluent levels shown in Table III-45. BOD5 and TSS final effluent levels for the treatment system shared by mills 020011 and 110068 are 36.7 and 34.9 percent below prorated BPT levels. BCT Option 4 flow and final effluent BOD5 and TSS levels for the semi-chemical subcategory are 43.0 kl/kkg (10.3 kgal/t), 1.2 kg/kkg (2.4 lb/t) and 2.2 kg/kkg (4.4 lb/t), respectively.

Unbleached Kraft and Semi-Chemical - A review of the BPT final effluent levels for the unbleached kraft and semi-chemical subcategory indicated that the BPT final effluent BOD5 concentration is considerably higher than for other subcategories with comparable raw waste BOD5 and underestimates the pollutant reduction capability in this subcategory. Therefore, to determine a more realistic set of best performing mills, the BPT final effluent BOD5 level was revised downward based on the relationship between BOD5 influent concentration and effluent concentration presented here previously and in the development document supporting the January 1977 Phase II BPT regulations (see reference 9, page 402). Using this methodology, the adjusted long-term average comparison level final effluent BOD5 is 1.9 kg/kkg (3.7 lb/t).

The general methodology was applied using the comparison level BOD5 as illustrated in Table III-46. The BOD5 comparison level and BPT TSS final effluent level are attained at mills 015001 and 015004. BCT Option 4 flow and final effluent BOD5 and TSS levels for the unbleached kraft and semi-chemical subcategory are 58.4 kl/kkg (14.0 kgal/t), 1.4 kg/kkg (2.7 lb/t) and 2.4 kg/kkg (4.7 lb/t), respectively.

Papergrade Sulfite (Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) Subcategories) - In reviewing these subcategories, as shown earlier in this section in the discussion on BCT Option 1 RWL development, EPA found that wastewater flow and BOD5 RWL are a function of the percentage of sulfite pulp manufactured on-site. An equation was developed relating flow to percent sulfite pulp manufactured on-site. The equation, which is representative of BPT flow for the papergrade sulfite subcategories, is (see Figure III-1):

TABLE III-45
DISCHARGE MONITORING REPORT DATA
SEMI-CHEMICAL SUBCATEGORY

Mill Number	Final Effluent Long-Term Average Levels: Flow kl/kkg	(kgal/t)	BOD5 kg/kkg	(lb/t)	TSS kg/kkg	(lb/t)	Start Date	Number Of Months Data: Flow	BOD5	TSS
020001	26.1	(6.26)	3.1	(6.10)	4.5	(8.93)	12/77	20	20	20
020002	25.4	(6.08)	3.4	(6.88)	3.7	(7.49)	07/78	29	29	29
020003(a)	40.5	(9.71)	0.4	(0.71)	1.5	(2.95)	04/78	25	25	25
020004(a)(b)	24.4	(5.84)	1.4	(2.80)	0.6	(1.29)	01/78	39	39	39
020006	13.6	(3.26)	2.7	(5.41)	4.4	(8.89)	05/78	36	36	36
020007	11.2	(2.69)	3.1	(6.28)	3.1	(6.11)	07/77	27	23	23
020008(a)(c)	11.7	(2.80)	1.1	(2.11)	2.2	(4.30)	08/78	28	28	28
020009(a)	28.5	(6.84)	1.9	(3.80)	3.4	(6.75)	10/78	27	26	27
020010	23.6	(5.65)	2.0	(3.94)	3.3	(6.51)	10/78	30	30	30
020011(a)(d)	17.6	(4.22)	1.2	(2.40)	2.6	(5.27)	11/78	27	28	28
020012	31.5	(7.55)	3.7	(7.46)	6.4	(12.76)	07/77	44	43	43
020014	26.5	(6.35)	3.8	(7.54)	7.1	(14.10)	07/78	30	30	30
020015	34.5	(8.27)	11.1	(22.13)	11.8	(23.67)	06/79	22	22	22
020016	37.9	(9.09)	2.6	(5.19)	4.6	(9.25)	06/80	07	07	07
020017	18.7	(4.47)	2.5	(4.99)	2.7	(5.36)	07/78	29	29	29
060004(a)	36.9	(8.85)	1.3	(2.53)	1.3	(2.61)	10/78	27	27	27
900011	49.8	(11.94)	4.3	(8.54)	6.4	(12.85)	08/77	33	31	31
BPT-Final Effluent Level	42.9	(10.3)	3.2	(6.4)	4.1	(8.1)				
BOD5 Comparison Level For NSPS			1.9	(3.8)						
Average of Mills Attaining BPT TSS and BOD5 Comparison Level			1.2	(2.36)	2.2	(4.40)				

(a) TSS is less than or equal to BPT; BOD5 is less than or equal to the BOD5 Comparison Level.
(b) Data are not included in the average because mill employs reverse osmosis.
(c) Data are not included in the average because this mill occasionally spray irrigates some effluent.
(d) This semi-chemical mill shares a joint treatment system with a paperboard from wastepaper mill. It contributes approximately 46 percent of the total production of both mills. Prorated BPT was determined. The percent effluent BOD5 and TSS reductions being attained were then applied to the BPT TSS effluent level and BOD5 comparison level for the subcategory to obtain the effluent levels shown.

TABLE III-46
DISCHARGE MONITORING REPORT DATA
UNBLEACHED KRAFT AND SEMI-CHEMICAL SUBCATEGORY

	Final Effluent Long-Term Average Levels						
Mill	Flow	BOD5	TSS	Start	Number Of Months Data		
Number	kl/kkg (kgal/t)	kg/kkg (lb/t)	kg/kkg (lb/t)	Date	Flow	BOD5	TSS
010017	37.3 (8.94)	2.6 (5.23)	4.1 (8.25)	03/78	34	34	34
015001(a)	43.6 (10.46)	1.9 (3.70)	3.1 (6.19)	01/78	39	39	39
015002(b)	36.3 (8.70)	1.7 (3.32)	3.8 (7.50)	09/77	42	41	41
015003	41.4 (9.91)	3.9 (7.78)	2.7 (5.39)	01/78	40	40	40
015004(a)	52.9 (12.68)	0.9 (1.70)	1.6 (3.20)	06/79	13	13	13
015005	36.7 (8.80)	2.4 (4.84)	1.6 (3.14)	01/78	32	32	32
015006	47.6 (11.41)	3.3 (6.69)	4.3 (8.64)	01/78	38	38	38
015007	56.3 (13.48)	2.1 (4.14)	5.1 (10.18)	10/78	29	29	29
015009(c)	51.0 (12.23)	4.8 (9.55)	5.2 (10.38)	07/77	18	18	18
BPT-Final Effluent Levels	58.4 (14.0)	3.0 (5.9)	3.6 (7.1)				
BOD$_5$ Comparison Level For NSPS		1.9 (3.7)					
Average of Mills Attaining BPT TSS and BOD$_5$ Comparison Level		1.4 (2.70)	2.4 (4.70)				

(a) TSS is less than or equal to BPT; BOD$_5$ is less than or equal to BOD$_5$ Comparison Level.

(b) Mill discharges some effluent to percolation ponds in the summer. Data are not representative of entire effluent discharge.

(c) Mill now produces bleached kraft products. Data presented are for the period prior to addition of bleaching processes.

flow (kl/kkg) = 1.890 x + 41.94
[flow (kgal/t) = 0.453 x + 10.05]

where x = percent sulfite pulp manufactured on-site.

As presented earlier, another equation (based on actual mill BOD5 RWL data) was assumed to represent BCT Option 1 BOD5 RWL since the linear regression curve representing this equation lies below the prorated BPT BOD5 RWLs of all the mills on which the equation is based (see Figure III-B). A "BPT-like" raw waste BOD5 equation was developed from the BCT Option 1 BOD5 RWL equation and was used as the basis for BCT Option 4 comparison level final effluent BOD5 and TSS equations.

The BCT Option 1 BOD5 RWL equation, from which the "BPT-like" BOD5 equation was derived, was developed from BOD5 RWL data from mills 040009, 040010, 040011, 040012, 040013, and 040020. All of these mills have long-term average BOD5 RWL less than their respective prorated BPT BOD5 RWLs, except for mill 040009 (see Table III-13). The percent of each mill's BOD5 RWL below its prorated BPT BOD5 RWL was calculated. The BOD5 RWL of the five mills with BOD5 levels less than their respective prorated BPT levels averaged 28.0 percent below BPT. The 28 percent reduction was used to back-calculate a "BPT-like" BOD5 RWL equation in the following manner. In the general discussion of the methodology used to determine BCT Option 1 raw waste loads, found at the beginning of Section III, the following equation was presented:

$$\text{BCT Option 1 flow} = (\text{BPT flow}) \times \left(1 - \frac{\text{average percent reduction}}{100}\right)$$

Substituting the BCT Option 1 raw waste BOD5 equation for the left side of the equation using 28 percent as the percent reduction, and solving for the BPT term (now BOD5 rather than flow) the following "BPT-like" equation is obtained:

Raw waste BOD5 (kg/kkg) = 0.86 x + 12.9
[Raw waste BOD5 (lb/t) = 1.72 x + 25.8]
where x = percent sulfite pulp manufactured on-site.

The equations developed above represent BPT flow and BPT BOD5 RWL for the papergrade sulfite subcategories. These equations were used to develop final effluent BOD5 and TSS comparison level equations which were used to identify BCT Option 4 best performers.

The comparison level equations which are functions of percent sulfite pulp were developed by applying the methodology explained in the discussion of the development of BCT Option 1 final effluent BOD5 and TSS equations for the papergrade sulfite subcategories and by using the BPT-like flow and the BOD5 RWL equations and the relationships between raw waste BOD5 concentration, final effluent BOD5 concentration, and final effluent TSS concentration. Raw waste BOD5 concentrations for several values of percent sulfite pulp were predicted from the BPT flow and raw waste BOD5 equations. These concentrations were substituted in the equation relating influent BOD5 concentration and final effluent BOD5 concentration to obtain final effluent BOD5 concentrations which, with the corresponding flows, were used to calculate final effluent BOD5 levels for each value of percent sulfite pulp used. The final effluent BOD5 levels and the associated values of percent sulfite pulp were used to develop an equation relating final effluent BOD5 to percent sulfite pulp by means of linear regression. The procedure was repeated to develop an equation relating final effluent TSS to percent sulfite pulp. The equations are:

Final effluent BOD5 (kg/kkg) $= 0.081\ x + 1.48$
[Final effluent BOD5 (lb/t) $= 0.161\ x + 2.95$], and
Final effluent TSS (kg/kkg) $= 0.113\ x + 2.23$
[Final effluent TSS (lb/t) $= 0.226\ x + 4.45$],

where x = percent sulfite pulp manufactured on-site.

These equations predict final effluent BOD5 and TSS levels as a function of the percent sulfite pulp manufactured on-site for a papergrade sulfite mill that discharges BPT RWLs to a biological treatment system representative of BPT. Since the equations predict effluent levels attained after biological treatment of BPT-like RWLs, EPA has used these equations as BOD5 and TSS final effluent comparison levels to identify a realistic set of BCT Option 4 best performers for the papergrade sulfite subcategories.

Values of comparison level final effluent BOD5 and TSS were calculated for each mill, as shown in Table III-47, based on mill-specific percent sulfite pulp produced on-site (see Table III-14) and the comparison level equations. Best performers were identified as those mills that had long-term average BOD5 and TSS final effluent levels less than their respective BOD5 and TSS comparison levels. The mills attaining BOD5 and TSS comparison levels are 040009, 040011, 040013, 040018, and 040019. Mills 040011, 040018, and 040009 were excluded from calculations. Mill 040011 was not included in the following calculations because it employs a two-stage biological treatment system which is not considered representative of the technology on which BPT is based. Mill 040018 discharges pulp mill wastes to a POTW and thus, was excluded from further calculations. Mill 040009 shares a joint wastewater treatment system with an alkaline-fine papers mill. Although the BOD5 and TSS effluent levels are lower than corresponding prorated BPT comparison levels for the joint treatment system, data from this treatment system was excluded from further calculations.

TABLE III-47
DISCHARGE MONITORING REPORT DATA
PAPERGRADE SULFITE SUBCATEGORY

Mill Number	Flow		BOD5					TSS					Number of Months Data		
	Long-Term Average		Comparison Level(a)		Long-Term Average		% Less than Comparison Level(b)	Comparison Level(a)		Long-Term Average		% Less than Comparison Level(b)			
	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	lb (lb/t)		kg/kkg	(lb/t)	kg/kkg	(lb/t)		Flow	BOD5	TSS
040001(c)	123.3	(29.55)	8.1	(16.15)	10.7	(21.30)		11.5	22.98	9.1	(18.10)		32	34	35
040002	305.3	(73.16)	9.6	(19.21)	14.9	(29.86)		13.6	27.28	25.4	(50.78)		19	21	21
040008(d)	219.1	(52.51)	7.8	(15.51)	10.3	(20.52)		11.0	22.08	12.4	(24.89)		9	9	9
040010(e)	258.3	(61.90)	4.1	(8.10)	6.4	(12.72)		5.8	11.68	6.1	(12.15)		46	46	45
040011(f)(g)	60.9	(14.60)	4.6	(9.23)	1.4	(2.89)		6.6	13.26	2.5	(4.92)		14	14	14
040012	258.1	(61.85)	7.3	(14.54)	11.1	(22.21)		10.4	20.72	14.2	(28.30)		31	33	32
040013(g)	100.9	(24.17)	6.7	(13.42)	4.5	(8.95)	33.3	9.6	19.14	7.4	(14.88)	22.3	17	17	17
040015	40.1	(9.62)	9.5	(19.05)	12.3	(24.68)		13.5	27.05	12.7	(25.34)		36	36	36
040016	116.4	(27.89)	6.4	(12.77)	6.5	(13.07)		9.1	18.24	14.9	(29.74)		35	16	44
040017	84.3	(20.21)	4.9	(9.71)	5.3	(10.57)		7.0	13.94	10.0	(20.09)		45	45	45
040018(h)	85.7	(20.53)	4.2	(8.42)	1.8	(3.61)		6.1	12.13	1.7	(3.48)		27	27	27
040019(g)	45.3	(10.86)	5.7	(11.32)	2.8	(5.66)	50.0	8.1	16.20	3.5	(7.09)	56.2	19	19	19
040009(g)(i)	89.3	(21.41)	3.9	(7.75)	1.5	(2.95)		6.2	12.46	4.8	(9.66)		21	21	21
Average % less Than Comparison Level for Mills Attaining Comparison Level BOD5 and TSS							41.7					39.3			
Final Effluent Comparison Levels in Terms of Percent Sulfite Pulp (x)			1.48 + 0.081x kg/kkg (2.95 + 0.161x) (lb/t)					2.23 + 0.113x kg/kkg (4.45 + 0.226x) (lb/t)							
(Comparison Level) x (100- Ave % less)/100			0.86 + 0.047x kg/kkg (1.72 + 0.094x) (lb/t)					1.35 + 0.069x kg/kkg (2.70 + 0.137x) (lb/t)							

(a) Comparison levels are found by substituting mill specific percent sulfite pulp manufactured on-site (x) into the final effluent comparison level equations for BOD5 and TSS.

(b) Percent less than comparison level = 100 x (final effluent comparison level - long-term average)/(final effluent comparison level).

(c) Data are not considered in the average because pulp is not bleached at this mill. Mill is now closed.

(d) Data are not considered in the average because less than 12 months data are available.

(e) Data are not considered in the average because glassine papers are produced at this mill and the flow is not typical of the subcategory. BOD5 and TSS may be typical but the mill is not a best performer.

(f) Data are not considered in the average because mill employs a 2-stage biological treatment system.

(g) BOD5 and TSS effluent levels are less than respective comparison levels.

(h) Pulp mill wastes are discharged to a POTW.

(i) This papergrade sulfite mill shares a joint treatment system with an alkaline-fine mill. It contributes approximately 48 percent of the total production of both mills. Prorated BPT was calculated and this mill was found to meet BPT levels. Data for this mill were not considered in the averages as the final effluent is not typical of the subcategory.

The percent reductions in BOD5 and TSS below the BCT Option 4 comparison levels for BOD5 and TSS for each of the best performers were determined and are presented in Table III-47. The averages of these reductions are 41.7 percent and 39.3 percent for BOD5 and TSS. Equations representing BCT Option 4 final effluent levels for BOD5 and TSS were obtained by reducing the comparison level final effluent BOD5 and TSS equations by 41.7 percent and 39.3 percent and are as follows:

BOD5 (kg/kkg) = 0.047 x + 0.86
[BOD5 (lb/t) = 0.094 x + 1.72]
TSS (kg/kkg) = 0.069 x + 1.35
[TSS (lb/t) = 0.137 x + 2.70]

Where x = percent sulfite pulp manufactured on-site.

Dissolving Sulfite Pulp - Available effluent data are presented in Table III-48. No best performing mills have been identified in the dissolving sulfite pulp subcategory; therefore, EPA relied on transfer of treatment system performance in the papergrade sulfite subcategories to the dissolving sulfite pulp subcategory to determine BCT Option 4 long-term average final effluent levels.

The technology transfer from the papergrade sulfite subcategories to the dissolving sulfite pulp subcategory is reasonable because EPA has determined that the characteristics and treatability of dissolving sulfite pulp wastewaters and the papergrade sulfite subcategories are similar. In fact, BPT effluent limitations for both subcategories were developed from the same relationship between BOD5 influent concentration and BOD5 effluent concentration. Therefore, the Agency believes that dissolving sulfite pulp mills can attain the BCT Option 4 long-term average final effluent levels developed.

As shown in the discussion of the development of BCT Option 4 final effluent characteristics for the papergrade sulfite subcategories, best performing mills in the papergrade sulfite subcategories attained BOD5 and TSS effluent levels averaging 41.7 percent and 39.3 percent below the BOD5 and TSS effluent comparison levels. Thus, BCT Option 4 long-term average final effluent BOD5 and TSS levels for mills in the dissolving sulfite pulp subcategory are assumed to be 41.7 percent and 39.3 percent below BPT BOD5 and TSS long-term average final effluent levels for each of the dissolving sulfite grades. They are as follows:

TABLE III-48
DISCHARGE MONITORING REPORT DATA
DISSOLVING SULFITE PULP SUBCATEGORY

Mill Number	Final Effluent Long-Term Average Levels: Flow kl/kkg (kgal/t)	BOD5 kg/kkg (lb/t)	TSS kg/kkg (lb/t)	Start Date	Number Of Months Data: Flow	BOD5	TSS
046001	224.0 (53.68)	35.4 (70.86)	22.4 (44.74)	07/77	41	43	43
046002	397.0 (95.14)	47.6 (95.17)	42.3 (84.59)	01/79	26	26	26
046003	277.5 (66.50)	40.1 (80.26)	11.9 (23.74)	12/80	7	7	7
046004(a)	174.5 (41.82)	10.3 (20.68)	28.9 (57.86)	04/79	18	18	17
046005	352.5 (84.47)	41.1 (82.28)	51.7 (103.32)	11/79	14	14	14
046006	135.0 (32.36)	26.2 (52.30)	14.2 (28.40)	07/77	42	42	42

BPT final effluent levels depend on grade of pulp manufactured, as follows:

	Flow kl/kkg (kgal/t)	BOD5 kg/kkg (lb/t)	TSS kg/kkg (lb/t)
Nitration	275.0 (66.0)	12.1 (24.2)	20.9 (41.8)
Viscose	275.0 (66.0)	13.0 (25.9)	20.9 (41.8)
Cellophane	275.0 (66.0)	14.1 (28.1)	20.9 (41.8)
Acetate(b)	302.1 (72.4)	17.8 (35.6)	23.0 (45.9)
Average Percentage performance Below Comparison Level, transferred from the papergrade Sulfite Subcategories		41.7	39.3

Option 4 long-term average final effluent levels for BOD5 and TSS depend on grade of pulp manufactured, and are 41.7% less than BPT for BOD5 and 39.3% less than BPT for TSS as shown below:

	BOD5 kg/kkg (lb/t)	TSS kg/kkg (lb/t)
Nitration	7.1 (14.1)	12.7 (25.4)
Viscose	7.6 (15.1)	12.7 (25.4)
Cellophane	8.2 (16.4)	12.7 (25.4)
Acetate(c)	10.4 (20.8)	14.0 (27.9)

(a) This mill shares a joint treatment system with a paper mill. Effluent data are not representative of the dissolving sulfite pulp subcategory.

(b) BOD5 and TSS effluent levels are representative of data associated with the production of acetate grade dissolving sulfite pulp at the time the remanded BPT BOD5 limitation was promulgated in 1977. BPT for acetate grade has not yet been repromulgated.

(c) Based on values shown above. See footnote (b).

	BCT Option 4 Long-term Average Final Effluent			
	BOD5		TSS	
	kg/kkg	(lb/t)	kg/kkg	(lb/t)
Grade				
Nitration	7.1	(14.1)	12.7	(25.4)
Viscose	7.6	(15.1)	12.7	(25.4)
Cellophane	8.2	(16.4)	12.7	(25.4)
Acetate	10.4	(20.8)	14.0	(27.9)

Groundwood Thermo-Mechanical - Available effluent data are presented in Table III-49. Sufficient data are not available to determine BCT Option 4 pollutant removals or the associated costs of implementation.

Groundwood-Fine Papers - As illustrated in Table III-50, the general methodolody was followed. BPT effluent levels are being attained at mills 052003, 052007, 052008, 052014, and 054014. In addition to these mills, mill 052009 was included in the calculation. At this integrated miscellaneous group mill where BPT effluent levels are attained, groundwood pulp is produced, a significant portion of which is used to manufacture fine papers. The approach used to include data for mill 052009 involved comparing the final effluent BOD5 and TSS levels to BPT final effluent BOD5 and TSS levels determined by prorating limitations from appropriate subcategories. The percentage reduction below prorated BPT attained at this mill was then applied to groundwood-fine papers BPT final effluent levels. BOD5 and TSS final effluent levels for mill 052009 are 14.6 percent and 26.5 percent below prorated BPT limitations.

Upon calculation of the BOD5 concentration corresponding to BCT Option 4 flow, EPA found that the resulting long-term average final effluent BOD5 concentration was less than 15 mg/l. Therefore, the BCT Option 4 long-term average final effluent BOD5 concentration was set at 15 mg/l and the effluent load was revised correspondingly upward. BCT Option 4 flow and final effluent BOD5 and TSS levels for the groundwood-fine papers subcategory are 91.4 kl/kkg (21.9 kgal/t), 1.4 kg/kkg (2.7 lb/t) and 2.0 kg/kkg (4.0 lb/t), respectively.

Groundwood-CMN Papers - As illustrated in Table III-51, the general methodology was followed. BPT effluent levels are attained at mill 054015. For the nine month period prior to December 1978, the long-term average TSS effluent level for this mill was 2.2 kg/kkg (4.4 lb/t). In November 1978, the NPDES authority increased the allowable TSS discharge. For the period after November 1978, the long-term average TSS effluent level was 5.2 kg/kkg (10.4 lb/t). This mill has demonstrated that 2.2 kg/kkg (4.4 lb/t) can be attained. Therefore, the long-term average TSS effluent level is based on performance at mill 054015

TABLE III-49
DISCHARGE MONITORING REPORT DATA
GROUNDWOOD-THERMO-MECHANICAL SUBCATEGORY

	Final Effluent Long-Term Average Levels						
Mill	Flow	BOD5	TSS	Start	Number Of Months Data		
Number	kl/kkg (kgal/t)	kg/kkg (lb/t)	kg/kkg (lb/t)	Date	Flow	BOD5	TSS
070001	87.9 (21.07)	1.6 (3.18)	2.7 (5.45)	05/79	20	20	20
070002	33.8 (8.10)	3.6 (7.29)	6.2 (12.38)	06/79	22	22	22
BPT-Final Effluent Levels	88.0 (21.1)	3.1 (6.2)	4.6 (9.2)				

TABLE III-50
DISCHARGE MONITORING REPORT DATA
GROUNDWOOD-FINE PAPERS SUBCATEGORY

	Final Effluent Long-Term Average Levels						
Mill	Flow	BOD5	TSS	Start	Number Of Months Data		
Number	kl/kkg (kgal/t)	kg/kkg (lb/t)	kg/kkg (lb/t)	Date	Flow	BOD5	TSS
052003(a)	71.6 (17.16)	0.8 (1.64)	3.0 (5.94)	08/77	8	41	41
052004	53.8 (12.89)	2.2 (4.47)	3.1 (6.11)	09/77	45	45	45
052007(a)	78.7 (18.87)	0.9 (1.87)	2.6 (5.14)	01/78	38	38	38
052008(a)	41.3 (9.89)	0.4 (0.87)	1.3 (2.53)	01/78	36	36	33
052009(a)(b)	78.5 (18.82)	1.7 (3.41)	2.5 (5.07)	07/77	37	30	30
052014(a)	37.1 (8.89)	0.3 (0.57)	0.4 (0.74)	02/78	39	39	40
054014(a)	35.6 (8.52)	1.3 (2.50)	2.3 (4.61)	05/78	33	33	33
BPT-Final Effluent Levels	91.0 (21.9)	2.0 (4.0)	3.5 (6.9)				
Average of Mills Attaining BPT BOD5 and TSS		0.9 (1.81)	2.0 (4.01)				
Option 1 Adjusted BOD5		1.4 (2.74)					

(a) TSS and BOD5 are less than or equal to BPT.

(b) Mill is an integrated miscellaneous mill where groundwood-fine papers comprise approximately 66 percent of the production. Prorated BPT was determined. The percent effluent BOD5 and TSS reductions below prorated BPT being attained were then applied to BPT BOD5 and TSS effluent levels for the subcategory to obtain the effluent levels shown.

TABLE III-51
DISCHARGE MONITORING REPORT DATA
GROUNDWOOD-CMN PAPERS SUBCATEGORY

Mill Number	Final Effluent Long-Term Average Levels			Start Date	Number Of Months Data		
	Flow kl/kkg (kgal/t)	BOD5 kg/kkg (lb/t)	TSS kg/kkg (lb/t)		Flow	BOD5	TSS
052015	69.0 (16.53)	3.8 (7.68)	2.8 (5.57)	01/78	24	25	25
054015(a)(b)	109.5 (26.25)	1.0 (1.99)	2.2 (4.41)	01/78	9	9	11
054015(b)	112.2 (26.89)	1.2 (2.48)	5.2 (10.44)	12/78	25	25	25
BPT-Final Effluent Levels	99.0 (23.8)	2.2 (4.4)	3.8 (7.5)				
Average of Mills Attaining BPT BOD5 and TSS		1.2 (2.35)(b)	2.2 (4.41)				
Option 1 Adjusted BOD5		1.5 (2.98)					

(a) TSS and BOD5 are less than or equal to BPT.

(b) Mill operated at the lower effluent levels listed above until their permitted TSS limits were relaxed, after which it operated at the higher levels. Long-term average BOD5 was determined by averaging data over the entire period for which there are DMR data (weighted average of the two periods).

prior to December 1978.

Upon calculation of the concentration of BOD5 corresponding to BCT Option 4 flow, EPA found that the resulting long-term average final effluent BOD5 concentration was less than 15 mg/l. Therefore, the BCT Option 4 long-term average final effluent BOD5 concentration was set at 15 mg/l, and the effluent load was revised correspondingly upward. BCT Option 4 flow and final effluent BOD5 and TSS levels for the groundwood-CMN papers subcategory are 99.3 kl/kkg (23.8 kgal/t), 1.5 kg/kkg (3.0 lb/t) and 2.2 kg/kkg (4.4 lb/t), respectively.

Deink - Available effluent data for this subcategory are shown in Table III-52. EPA has divided the deink subcategory into three sectors: fine papers, tissue papers, and newsprint. BCT Option 4 effluent limitations have been developed for only the fine and tissue papers sectors of the deink subcategory. Most mills in these sectors employ some purchased pulp; BPT limitations were based on mills producing products from a furnish of deinked pulp, 100 percent of which was deinked on-site. Therefore, BCT Option 4 limitations were also developed for mills employing a furnish of deinked pulp, 100 percent of which is produced on-site. The modified methodology, based on comparison with prorated BPT effluent levels, was used to develop BCT Option 4 effluent levels.

Since most mills in the fine and tissue papers sectors achieve BOD5 and TSS effluent levels below their respective prorated BPT levels, EPA did not feel that the average of data from all of these mills truly reflected the performance of BCT. Thus, to identify a realistic set of best performers, EPA developed effluent comparison levels for each of the sectors based on BPT flow, BPT comparison level BOD5 RWLs, chemically assisted primary clarification, and the application of the equations relating secondary influent BOD5 concentration to effluent BOD5 and TSS concentrations.

At the time of BPT development, no distinction was made between the sectors of the deink subcategory; therefore, the same BPT BOD5 RWL was applied to all sectors. BOD5 RWLs have been developed for the fine and tissue papers sectors by adjusting individual mill BOD5 RWLs to the levels that would be expected if each mill deinked 100 percent of its furnish (see discussion of the development of BCT Option 1 RWLs for the deink subcategory). The adjusted BOD5 RWLs, 68.9 kg/kkg (137.7 lb/t) for deink-fine papers and 94.6 kg/kkg (189.2 lb/t) for deink-tissue papers, were taken as the basis of the BCT Option 4 final effluent comparison levels.

Data presented in Table III-18 indicate that mills in the deink subcategory achieve substantial BOD5 reduction through primary clarification. The average reduction in BOD5 was found to be 42.8 percent with chemical assistance (see discussion of the development of BCT Option 1 RWLs for the deink subcategory). Thus, the BOD5 RWLs (presented above) that are the basis for the

TABLE III-52
DISCHARGE MONITORING REPORT DATA
DEINK SUBCATEGORY

Mill Number	Final Effluent Flow Long-Term Average (kl/kkg)	Final Effluent Flow Long-Term Average (kgal/t)	Final Effluent BOD5 Prorated Comparison Level(a) (kg/kkg)	Final Effluent BOD5 Prorated Comparison Level(a) (lb/t)	Final Effluent BOD5 Long-Term Average (kg/kkg)	Final Effluent BOD5 Long-Term Average (lb/t)	Final Effluent BOD5 % Less Than Prorated BPT(b)	Final Effluent TSS Prorated Comparison Level(a) (kg/kkg)	Final Effluent TSS Prorated Comparison Level(a) (lb/t)	Final Effluent TSS Long-Term Average (kg/kkg)	Final Effluent TSS Long-Term Average (lb/t)	Final Effluent TSS % Less Than Prorated BPT(b)	Number of Months Data Flow	Number of Months Data BOD5	Number of Months Data TSS
Fine Papers															
140007(c)	48.0	(11.50)	3.0	(5.94)	2.2	(4.37)	26.4	4.6	(9.15)	4.0	(8.00)	12.6	39	39	39
140008	87.9	(21.06)	3.1	(6.16)	4.7	(9.41)		4.8	(9.66)	5.0	(9.96)		15	15	15
140019(c)	31.2	(7.48)	3.1	(6.27)	2.0	(3.98)	36.5	5.0	(9.92)	3.8	(7.50)	24.4	44	43	44
Average percent reduction below prorated comparison level BOD5 and TSS							31.5					18.5			
Newsprint															
900017(c)(d)	56.1	(13.44)			1.4	(2.82)				1.1	(2.18)		15	15	15
BPT-Final Effluent Levels	102.0	(24.4)			5.3	(10.6)				7.1	(14.2)				
Tissue Papers															
140014(c)	76.0	(18.21)	4.0	(8.09)	2.9	(5.77)	28.7	6.2	(12.39)	3.0	(6.00)	51.6	13	13	13
140015(c)	94.6	(22.67)	4.2	(8.40)	3.4	(6.84)	16.6	6.4	(12.70)	4.7	(9.43)	25.7	43	43	43
140018(c)(e)	17.6	(4.22)	4.1	(8.24)	3.1	(6.20)		6.3	(12.54)	1.4	(2.84)		10	9	10
140021(c)	100.1	(23.99)	4.2	(8.40)	2.2	(4.40)	47.6	6.4	(12.70)	4.1	(8.16)	35.7	42	42	42
140022(c)(e)	77.9	(18.67)	3.0	(5.96)	1.1	(2.23)		5.1	(10.26)	1.2	(2.32)		9	9	9
140024	7.9	(1.90)	4.2	(8.40)	12.1	(24.14)		6.4	(12.70)	7.2	(14.40)		44	44	44
140025	57.9	(13.87)	3.8	(7.62)	4.3	(8.68)		6.0	(11.92)	4.5	(8.92)		26	26	26
140030(c)	68.1	(16.33)	3.6	(7.20)	2.0	(3.91)	45.7	5.8	(11.50)	2.5	(5.05)	56.1	45	47	47
900015(c)(f)	47.7	(11.44)	4.2	(8.40)	1.4	(2.89)		6.4	(12.70)	1.5	(3.01)		18	18	18
900018	55.0	(13.18)	2.7	(5.38)	8.1	(16.25)		4.8	(9.68)	2.7	(5.40)		29	45	45
900020	134.4	(32.20)	9.2	(18.40)	9.1	(18.26)		6.4	(12.70)	15.4	(30.76)		24	24	24
Average percent reduction below prorated comparison level BOD5 and TSS							35.2					42.3			

TABLE III-52 (Cont'd)
DISCHARGE MONITORING REPORT DATA
DEINK SUBCATEGORY

Mill Number	Final Effluent Flow Long-Term Average (kl/kkg)	Final Effluent Flow Long-Term Average (kgal/t)	Final Effluent BOD5 Prorated Comparison Level(a) (kg/kkg)	Final Effluent BOD5 Prorated Comparison Level(a) (lb/t)	Final Effluent BOD5 Long-Term Average (kg/kkg)	Final Effluent BOD5 Long-Term Average (lb/t)	Final Effluent BOD5 % Less Than Prorated BPT(b)	Final Effluent TSS Prorated Comparison Level(a) (kg/kkg)	Final Effluent TSS Prorated Comparison Level(a) (lb/t)	Final Effluent TSS Long-Term Average (kg/kkg)	Final Effluent TSS Long-Term Average (lb/t)	Final Effluent TSS % Less Than Prorated BPT(b)	Start Date	Number of Months Data Flow	Number of Months Data BOD5	Number of Months Data TSS
Average percent reduction below prorated comparison level BOD5 and TSS for the Fine Papers and Tissue Papers Sectors							33.9					34.4				

(a) Prorated BPT is based on percentage of different products manufactured at each mill. Prorated BPT (for flow/BOD5/TSS) = (BPT for Deink) (% deinked pulp) + (BPT for nonintegrated-fine/tissue papers) (% nonintegrated-fine/tissue papers)

(b) Percent less than prorated BPT = 100 x (prorated BPT - long-term average)/(prorated BPT).

(c) TSS and BOD5 are less than or equal to BPT.

(d) This mill employs chemically assisted secondary clarification. Data were not used in developing BCT Option 4 final effluent loads.

(e) Data are not included in the average because less than 12 months data are available.

(f) Data are not included in the average because this is a state-of-the-art mill.

Option 4 comparison level for the two sectors are reduced by 42.8 percent to obtain the secondary influent BOD5 waste loads, which are 39.4 kg/kkg (78.8 lb/t) and 54.1 kg/kkg (108.2 lb/t) for the deink-fine and tissue papers sectors, respectively. Corresponding secondary influent BOD5 concentrations were then calculated.

These influent concentrations, with the equations relating influent BOD5 concentration and effluent BOD5 and TSS concentrations (discussed previously and in the Phase II Development Document, reference 9, pg. 402, and the October 1980 Proposal Development Document, reference 1, pg. 380) were used to predict final effluent BOD5 and TSS concentrations. BCT Option 4 BOD5 and TSS effluent comparison levels were determined from these concentrations by multiplying each by BPT flow. The comparison levels, shown below, were used to identify best performers in the two sectors.

BCT Option 4 Comparison Levels

	BOD5		TSS	
Grade	kg/kkg	(lb/t)	kg/kkg	(lb/t)
Deink-Fine Papers	3.5	(7.0)	5.8	(11.6)
Deink-Tissue Papers	4.2	(8.4)	6.4	(12.7)

The BCT Option 4 comparison levels reflect performance of mills which deink 100 percent of the pulp used in their furnish. Therefore, the comparison levels for mills that purchase pulp must be prorated with BOD5 and TSS effluent levels reflecting BPT performance for the nonintegrated-fine papers and nonintegrated-tissue papers subcategories, as appropriate. Comparison levels for mills in the fine papers sector were determined by prorating the deink-fine papers final effluent comparison levels for BOD5 and TSS with the BPT final effluent BOD5 and TSS levels for the nonintegrated-fine papers subcategory (wood fibers sector).

However, the BPT final effluent BOD5 and TSS levels of the nonintegrated tissue papers subcategory do not reflect biological treatment of RWLs, whereas RWLs from mills in the tissue papers sector of the deink subcategory do receive biological treatment. To predict final effluent levels reflecting biological treatment of RWLs from nonintegrated-tissue papers mills, the relationships between influent BOD5 concentration and effluent BOD5 and TSS concentrations were applied to the BPT raw waste BOD5 concentration of the nonintegrated-tissue papers subcategory. The final effluent BOD5 and TSS loads, obtained by multiplying the predicted BOD5 and TSS effluent concentrations by the BPT flow for the nonintegrated tissue papers subcategory are 1.6 kg/kkg (3.2 lb/t) for BOD5 and 3.8 kg/kkg (7.5 lb/t) for TSS. Prorated comparison levels for deink-tissue mills that purchase pulp are, thus, determined by prorating the BOD5 and TSS effluent comparison levels with the BOD5 and TSS levels obtained as above for the nonintegrated-tissue papers subcategory.

Prorated comparison levels are presented in Table III-52, with available effluent data for mills in the deink subcategory. Mills in the fine papers sector that attain prorated comparison levels are 140007 and 140019. Mills in the tissue papers sector that attain prorated comparison levels are 140014, 140015, 140018, 140021, 140022, 140030, and 900015. Mills 140018 and 140022 were not used to determine BCT Option 4 effluent levels as only 10 months of data are available for each mill. Mill 900015 was also not used because it employs a state-of-the-art treatment system that is not representative of BPT.

The percent reductions in BOD5 and TSS below the prorated comparison levels for BOD5 and TSS were determined for each best performer. The average percent reduction of all best performers (in the fine papers sector and the tissue papers sector combined) was found to be 33.9 percent for BOD5 and 34.4 percent for TSS. Data for both sectors were combined because of the similar RWL treatability of the two sectors and the similarity in design parameters for BCT Option 4 treatment systems.

BCT Option 4 final effluent levels for BOD5 and TSS for mills in the fine papers sector of the deink subcategory that use pulp, 100 percent of which is deinked on-site, are, therefore, 33.9 percent less and 34.4 percent less than the sector's effluent comparison levels. The final effluent levels for mills in the tissue papers sector are also 33.9 percent and 34.4 percent less than that sector's effluent comparison levels for BOD5 and TSS, respectively. These values are presented in the following table with the final effluent levels developed using the BCT Option 1 methodology for comparison.

Deink-Fine Papers

	BOD5		TSS	
	kg/kkg	(lb/t)	kg/kkg	(lb/t)
Option 1	2.5	(5.0)	3.3	(6.5)
Option 4	2.3	(4.6)	3.8	(7.6)

Deink-Tissue Papers

	BOD5		TSS	
	kg/kkg	(lb/t)	kg/kkg	(lb/t)
Option 1	3.3	(6.5)	4.0	(8.0)
Option 4	2.8	(5.5)	4.2	(8.3)

As shown, the BOD_5 and TSS effluent characteristics obtained for both sectors of the deink subcategory employing the Option 4 methodology are nearly equal to the values obtained employing the BCT Option 1 methodology.

Thus, the same effluent levels can be attained by use of BCT Option 1 process controls (including chemically assisted primary clarification and recycle of primary clarifier effluent) or by upgrading the wastewater treatment system (including chemically assisted primary clarification). Therefore, BCT Option 1 effluent characteristics have been set equal to BCT Option 4 effluent characteristics. Since it is assumed that these effluent levels can be attained by the use of either set of technologies (process control or end-of-pipe treatment), the higher effluent characteristic of each pair has been chosen as the BCT Option 1 and Option 4 final effluent characteristics, as follows:

BCT Option 1 & BCT Option 4 Final Effluent Characteristics

	BOD5		TSS	
	kg/kkg	(lb/t)	kg/kkg	(lb/t)
Deink-Fine Papers	2.5	(5.0)	3.8	(7.6)
Deink-Tissue Papers	3.3	(6.5)	4.2	(8.3)

Sufficient data are not available to determine BCT Option 4 pollutant removals or determine the associated costs of implementation for the newsprint sector of the deink subcategory.

Tissue from Wastepaper - Extensive use of production process controls to reduce wastewater discharge is practiced in the tissue from wastepaper subcategory.

BCT Option 4 for this subcategory is identical to BCT Option 1 and includes the application of production process controls and biological treatment. The methodology for development of long-term average effluent levels is described in detail previously in this section under the Development of BCT Option 1 Effluent Characteristics. BCT Option 4 flow and final effluent BOD_5 and TSS levels for the tissue from wastepaper subcategory are 68.0 kl/kkg (16.3 kgal/t), 1.3 kg/kkg (2.6 lb/t) and 2.8 kg/kkg (5.7 lb/t), respectively. Available effluent data for mills in this subcategory are presented in Table III-53.

Paperboard from Wastepaper - Extensive use of production process controls to reduce wastewater discharge is practiced in the paperboard from wastepaper subcategory. BCT Option 4 for this subcategory is identical to BCT Option 1 and includes the application of production process controls and biological treatment. The methodology for development of long-term average effluent characteristics for both subdivisions of this subcategory is described in detail previously in this section (see Development of BCT Option 1 Effluent Characteristics). BCT

TABLE III-53
DISCHARGE MONITORING REPORT DATA
TISSUE FROM WASTEPAPER SUBCATEGORY(a)

Mill Number	Final Effluent Long-Term Average Levels			Start Date	Number Of Months Data		
	Flow kl/kkg (kgal/t)	BOD5 kg/kkg (lb/t)	TSS kg/kkg (lb/t)		Flow	BOD5	TSS
085004(g)	44.1 (10.57)	1.8 (3.63)	2.0 (4.08)	02/78	38	38	38
090002(b)(g)	40.5 (9.70)	3.3 (6.52)	1.4 (2.86)	07/77	33	32	33
090004(g)	53.7 (12.86)	3.7 (7.36)	1.9 (3.82)	07/77	38	38	38
090010(c)(g)	91.9 (22.03)	1.2 (2.38)	0.8 (1.59)	07/77	43	43	42
090014(d)	92.4 (22.15)	5.8 (11.58)	3.6 (7.17)	03/79	25	25	25
100001(e)	98.8 (23.68)	5.3 (10.52)	10.6 (21.24)	07/77	38	39	39
100005(g)	29.4 (7.05)	1.8 (3.69)	1.3 (2.56)	09/77	41	42	29
100013(g)	38.9 (9.31)	1.7 (3.44)	3.3 (6.50)	07/78	33	31	33
100014(f)(g)	3.9 (0.94)	1.3 (2.53)	0.3 (0.63)	07/77	14	14	14
100016(d)	226.8 (54.35)	35.0 (70.02)	106.1(212.15)	01/78	37	38	38
BPT-Final Effluent Levels	105.2 (25.2)	4.0 (8.0)	5.1 (10.1)				

(a) BCT Option 4 final effluent levels are the same as those determined for BCT Option 1.

(b) Mill has no external treatment.

(c) These data are representative of one 4-hour composite sample per month.

(d) This mill employs primary treatment only.

(e) Since 7/79 this mill has been required to monitor BOD_5 only once per month and TSS only once per 4 months.

(f) This mill employed primary treatment only. The mill is now closed.

(g) TSS and BOD_5 are less than or equal to BPT.

Option 4 flow and final effluent BOD5 and TSS levels for the noncorrugating medium sector of the paperboard from wastepaper subcategory are 13.4 kl/kkg (3.2 kgal/t), 0.73 kg/kkg (1.5 lb/t) and 0.97 kg/kkg (1.9 lb/t), respectively, and for the corrugating medium sector are 13.4 kl/kkg (3.2 kgal/t), 1.1 kg/kkg (2.2 lb/t), and 1.2 kg/kkg (2.4 lb/t), respectively. Available effluent data for mills in both sectors of this subcategory are presented in Table III-54.

Wastepaper-Molded Products - Extensive use of production process controls to reduce wastewater discharge is practiced in the wastepaper-molded products subcategory. BCT Option 4 for this subcategory is identical to BCT Option 1 and includes the application of production process controls and biological treatment. The methodology for development of long-term average effluent characteristics is described in detail previously in this section under Development of BCT Option 1 Effluent Characteristics. BCT Option 4 flow and final effluent BOD5 and TSS levels for the wastepaper-molded products subcategory are 23.8 kl/kkg (5.7 kgal/t), 0.60 kg/kkg (1.2 lb/t) and 1.1 kg/kkg (2.3 lb/t), respectively. Available effluent data for mills in this subcategory are presented in Table III-55.

Builders' Paper and Roofing Felt - Extensive use of production process controls to reduce wastewater discharge is practiced in the builders' paper and roofing felt subcategory. BCT Option 4 for this subcategory is identical to BCT Option 1 and includes the application of production process controls and biological treatment. The methodology for development of long-term average effluent characteristics is described in detail previously in this section under Development of BCT Option 1 Effluent Characteristics. BCT Option 4 flow and final effluent BOD5 and TSS levels for the builders' paper and roofing felt subcategory are 11.3 kl/kkg (2.7 kgal/t), 0.53 kg/kkg (1.1 lb/t) and 0.76 kg/kkg (1.5 lb/t), respectively. Available effluent data for mills in this subcategory are presented in Table III-56.

Nonintegrated-Fine Papers - Two sectors of the nonintegrated-fine papers subcategory have been identified: the wood fiber furnish and cotton fiber furnish sectors.

As illustrated in Table III-57, the general methodology was followed for the wood fiber furnish sector. However, data for mills where only primary treatment is used were excluded from the computations.

Data were reviewed with respect to waste significant grade changes. No significant difference due to grade change was noted; thus, the combined data were used. BPT effluent levels are attained through the application of biological treatment at mills 080007, 080027, 080041, and 080046. Mill 080027 was excluded from the calculations because chemically assisted clarification is employed at that mill. BCT Option 4 flow and final effluent BOD5 and TSS levels for the wood fibers sector of the nonintegrated-fine papers subcategory are 63.4 kl/kkg (15.2

TABLE III-54
DISCHARGE MONITORING REPORT DATA
PAPERBOARD FROM WASTEPAPER SUBCATEGORY(a)

	Final Effluent Long-Term Average Levels				Number Of Months Data		
Mill Number	Flow kl/kkg (kgal/t)	BOD5 kg/kkg (lb/t)	TSS kg/kkg (lb/t)	Start Date	Flow	BOD5	TSS
Noncorrugating Medium Furnish							
110001(b)(i)	20.7 (4.96)	0.1 (0.27)	0.3 (0.67)	07/77	37	36	38
110019(i)	29.9 (7.16)	1.0 (1.97)	1.1 (2.28)	08/77	25	33	38
110020	35.8 (8.57)	0.8 (1.66)	1.4 (2.79)	08/77	41	42	42
110022(b)	68.1 (16.31)	1.7 (3.46)	2.2 (4.45)	01/78	20	20	20
110023	11.9 (2.85)	1.3 (2.58)	1.3 (2.62)	07/77	45	45	45
110031(i)	7.6 (1.83)	0.1 (0.27)	0.2 (0.38)	07/77	42	41	42
110032(c)(i)	25.8 (6.18)	0.9 (1.76)	1.1 (2.21)	04/78	34	35	35
110034(i)	6.0 (1.44)	1.1 (2.11)	0.8 (1.56)	05/79	22	16	17
110043(i)	17.1 (4.09)	0.8 (1.56)	1.2 (2.32)	07/77	29	43	43
110052(i)	23.8 (5.71)	0.4 (0.77)	0.5 (1.02)	09/77	13	13	13
110060(d)	2.6 (0.63)	2.2 (4.45)	0.2 (0.36)	04/78	16	16	16
110061(e)(i)	19.6 (4.69)	0.8 (1.58)	1.1 (2.28)	07/77	46	46	46
110062(i)	10.4 (2.49)	0.5 (1.09)	0.6 (1.21)	01/79	27	27	27
110067(i)	15.4 (3.69)	0.4 (0.86)	0.8 (1.63)	07/78	29	30	30
110069(i)	29.3 (7.01)	0.2 (0.46)	0.7 (1.48)	01/79	24	25	25
110070(i)	18.7 (4.49)	0.3 (0.57)	0.3 (0.52)	07/77	43	43	40
110074(i)	3.8 (0.91)	0.1 (0.24)	0.3 (0.62)	09/78	30	30	30
110077(i)	2.3 (0.54)	0.2 (0.33)	0.2 (0.41)	01/78	15	15	15
110080	32.6 (7.82)	2.8 (5.62)	2.8 (5.57)	01/80	14	14	14
110094(i)	21.8 (5.23)	0.5 (0.95)	0.7 (1.35)	07/77	45	45	45
110096(i)	--- (f)	0.1 (0.15)	0.0 (0.04)	10/78	27	27	27
110100(d)(g)	--- ---	4.4 (8.83)	1.5 (3.04)	05/78	0	8	8
110103(c)(i)	18.5 (4.44)	0.2 (0.35)	0.3 (0.66)	02/79	26	26	26
110104(h)(i)	1.0 (0.23)	1.1 (2.27)	0.4 (0.70)	01/79	24	27	27
110110(i)	4.9 (1.18)	0.2 (0.39)	0.8 (1.61)	04/79	25	25	25
110113(i)	17.3 (4.14)	0.8 (1.69)	1.6 (3.22)	07/77	46	46	46
110119	12.1 (2.91)	2.7 (5.34)	0.5 (0.93)	07/78	9	21	21

TABLE III-54 (Continued)
DISCHARGE MONITORING REPORT DATA
PAPERBOARD FROM WASTEPAPER SUBCATEGORY

Mill Number	Final Effluent Long-Term Average Levels			Start Date	Number Of Months Data		
	Flow kl/kkg (kgal/t)	BOD5 kg/kkg (lb/t)	TSS kg/kkg (lb/t)		Flow	BOD5	TSS
110127	12.6 (3.02)	0.9 (1.81)	0.8 (1.50)	07/77	34	34	34
110131(b)(h)	16.2 (3.88)	4.9 (9.82)	1.1 (2.23)	01/78	24	21	21
110134	11.2 (2.69)	1.7 (3.31)	2.4 (4.82)	10/78	27	27	27
110141(e)	8.0 (1.92)	1.5 (2.99)	0.6 (1.12)	07/77	39	42	42
110144	8.5 (2.04)	1.6 (3.23)	1.3 (2.54)	01/80	16	16	16
110147	6.0 (1.43)	1.7 (3.35)	1.4 (2.82)	07/77	25	25	26
110151(i)	15.7 (3.76)	1.2 (2.45)	0.9 (1.72)	07/77	9	9	9
900023(c)(i)	28.4 (6.80)	0.3 (0.62)	0.4 (0.74)	07/77	45	44	44
900024(g)(i)	2.1 (0.50)	0.0 (0.08)	0.1 (0.12)	10/77	36	33	33
900026(i)	34.2 (8.20)	0.1 (0.24)	0.8 (1.52)	02/79	19	20	20
BPT-Final Effluent Levels	30.0 (7.2)	0.9 (1.7)	1.2 (2.3)				
Corrugating Medium Furnish							
110025(i)	7.6 (1.82)	0.8 (1.67)	1.5 (3.04)	03/79	21	21	21
110054	58.6 (14.05)	1.7 (3.35)	0.4 (0.88)	07/78	12	12	12
110057(i)	6.7 (1.60)	0.9 (1.71)	0.6 (1.23)	07/77	46	46	46
BPT-Final Effluent Levels	30.0 (7.2)	1.6 (3.1)	2.1 (4.2)				

(a) BCT Option 4 final effluent levels are the same as those determined for BCT Option 1.
(b) Mill is now closed.
(c) Biological treatment is followed by sand filtration.
(d) Mill is scheduled to discharge to a POTW.
(e) This mill spray irrigates a portion of its final effluent; data presented are not representative of total discharge.
(f) Flows are generally less than 0.005 kgal/ton.
(g) Mill has no external treatment system.
(h) Mill has primary treatment only.
(i) BOD5 and TSS are less than or equal to prorated BPT for this mill. Prorated BPT has been determined for each mill based on the percent corrugated medium furnish employed by the mill.

TABLE III-55
DISCHARGE MONITORING REPORT DATA
WASTEPAPER-MOLDED PRODUCTS SUBCATEGORY(a)

Mill Number	Final Effluent Long-Term Average Levels						Start Date	Number Of Months Data		
	Flow		BOD5		TSS					
	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)		Flow	BOD5	TSS
150007(b)	56.7	(13.58)	12.0	(24.05)	13.3	(26.51)	10/79	12	12	12
150011	48.2	(11.55)	3.2	(6.36)	3.5	(6.91)	09/78	28	28	28
150021(b)(c)	1456.2	(348.96)	1.9	(3.87)	4.0	(7.91)	07/77	30	30	30
150025(d)(e)(f)	105.5	(25.29)	0.7	(1.38)	0.7	(1.37)	01/78	12	11	11
BPT-Final Effluent Levels	88.1	(21.1)	1.3	(2.6)	3.2	(6.4)				

(a) BCT Option 4 final effluent levels are the same as those determined for BCT Option 1.
(b) This mill has no external treatment system.
(c) Mill is now closed.
(d) Effluent combined with non-contact cooling water.
(e) This mill has primary treatment only.
(f) TSS and BOD5 are less than or equal to BPT.

TABLE III-56
DISCHARGE MONITORING REPORT DATA
BUILDERS' PAPER AND ROOFING FELT SUBCATEGORY(a)

	Final Effluent Long-Term Average Levels				Number Of Months Data		
Mill Number	Flow kl/kkg (kgal/t)	BOD5 kg/kkg (lb/t)	TSS kg/kkg (lb/t)	Start Date	Flow	BOD5	TSS
120004(c)	2.3 (0.54)	0.2 (0.31)	0.5 (1.01)	07/77	42	39	42
120006(b)(c)	115.8 (27.74)	1.0 (2.09)	0.3 (0.67)	07/77	47	47	40
120008	27.4 (6.56)	1.6 (3.11)	1.7 (3.30)	07/77	31	32	32
120020(b)(c)	13.0 (3.11)	0.1 (0.11)	0.1 (0.21)	07/78	34	34	34
120021(c)	0.2 (0.05)	0.4 (0.77)	0.0 (0.08)	10/79	4	19	19
BPT-Final Effluent Levels	60.1 (14.4)	1.6 (3.2)	1.6 (3.2)				

(a) BCT Option 4 final effluent levels are the same as those determined for BCT Option 1.
(b) This mill has primary treatment only.
(c) TSS and BOD5 are less than or equal to BPT.

TABLE III-57
DISCHARGE MONITORING REPORT DATA
NONINTEGRATED-FINE PAPERS SUBCATEGORY

	Final Effluent Long-Term Average Levels				Number Of Months Data		
Mill Number	Flow kl/kkg (kgal/t)	BOD5 kg/kkg (lb/t)	TSS kg/kkg (lb/t)	Start Date	Flow	BOD5	TSS
Wood Fiber Furnish							
080007(a)	55.5 (13.31)	1.4 (2.88)	1.6 (3.28)	08/77	40	41	40
080009(b)	65.5 (15.69)	3.3 (6.60)	1.7 (3.48)	01/78	36	36	36
080018	30.2 (7.24)	2.8 (5.57)	2.0 (3.94)	09/78	25	25	25
080027(a)(c)	30.6 (7.34)	0.9 (1.82)	0.7 (1.31)	01/78	38	38	38
080030(b)	22.5 (5.39)	--- ---	24.2 (48.48)	07/77	27	0	27
080033(b)	45.4 (10.87)	4.7 (9.40)	2.6 (5.25)	07/77	40	41	41
080040(b)(d)	103.0 (24.69)	13.4 (26.71)	14.6 (29.21)	07/77	9	9	9
080041(a)	113.9 (27.29)	1.7 (3.40)	1.4 (2.72)	11/78	28	28	28
080046(a)	53.2 (12.75)	1.1 (2.21)	1.8 (3.54)	03/79	25	25	25
080048(b)(d)	65.0 (15.57)	11.0 (22.09)	1.1 (2.15)	04/79	24	24	24
080049(b)	46.4 (11.11)	4.1 (8.17)	5.3 (10.60)	08/78	31	31	31
080051	53.5 (12.82)	2.7 (5.42)	2.5 (5.04)	10/79	16	16	16
105047(a)(b)	49.4 (11.84)	1.8 (3.51)	1.1 (2.18)	07/77	39	45	45
900059(b)	40.4 (9.69)	3.0 (6.04)	1.6 (3.20)	11/77	40	40	40
BPT-Final Effluent Levels	63.0 (15.2)	2.4 (4.8)	3.3 (6.5)				
Average of Mills Attaining BPT BOD5 and TSS		1.4 (2.83)	1.6 (3.18)				
Cotton Fiber Furnish							
080003(a)	169.4 (40.59)	3.7 (7.33)	2.7 (5.44)	07/77	46	46	46
080032(e)	68.7 (16.46)	2.0 (3.98)	0.8 (1.65)	01/79	28	27	28
080042(d)	67.4 (16.15)	10.7 (21.35)	29.3 (58.61)	07/78	18	18	18
080044	155.4 (37.25)	6.9 (13.77)	2.2 (4.49)	11/79	13	14	14
BPT-Final Effluent Levels	176.5 (42.3)	5.1 (10.2)	7.2 (14.3)				

(a) TSS and BOD5 are less than or equal to BPT.
(b) Data are not included in the average because this mill employs primary treatment only.
(c) Data are not included in the average because the mill employs chemically assisted clarification.
(d) This mill now discharges to a POTW.
(e) This mill discharges a variable amount of raw wastewater to a POTW.

kgal/t), 1.4 kg/kkg (2.8 lb/t) and 1.6 kg/kkg (3.2 lb/t), respectively.

EPA based BCT Option 4 effluent levels for the cotton fibers furnish sector of the nonintegrated-fine papers subcategories on the transfer of the performance of biological treatment characteristic of the wood fiber furnish sector. EPA applied the average percent reduction of BOD5 and TSS below BPT effluent levels at the best performing mills in the wood fiber furnish sector (41.0 percent for BOD5 and 51.1 percent for TSS) to BPT final effluent levels for the cotton fiber furnish sector. EPA determined that the characteristics and treatability of wastewaters discharged from mills in both subcategory sectors are similar. Therefore, the Agency believes that mills in the cotton fiber furnish sector will be able to attain the BCT Option 4 long-term average discharge characteristics. BCT Option 4 flow and final effluent BOD5 and TSS levels for the cotton fibers sector of the nonintegrated-fine papers subcategory are 176.5 kl/kkg (42.3 kgal/t), 3.0 kg/kkg (6.0 lb/t) and 3.5 kg/kkg (7.0 lb/t), respectively. Available effluent data for mills in this sector of the nonintegrated-fine papers subcategory are presented in Table III-57.

Nonintegrated-Tissue Papers - The general methodology was followed, as illustrated in Table III-58. However, because BPT was identified as primary clarification, data for mills where biological treatment is employed were excluded from the computations. BPT final effluent levels are attained through the application of primary treatment at mills 090008, 090011, 090013, 090022, 090024, and 090028. Data were reviewed with respect to waste significant grade changes in three specific delineations: none, less than one per day, and greater than one per day. For mills with data available on grade change, EPA found that long-term average discharge levels varied with grade change frequency. BCT Option 4 effluent levels are based on the delineation with the highest average long-term average final effluent levels: mills with less than one grade change per day (mills 090011 and 090022). BCT Option 4 flow and final effluent BOD5 and TSS levels for the nonintegrated-tissue papers subcategory are 95.6 kl/kkg (22.9 kgal/t), 2.7 kg/kkg (5.5 lb/t) and 1.9 kg/kkg (2.9 lb/t), respectively.

Nonintegrated-Lightweight Papers - EPA based BCT Option 4 effluent levels on the transfer of performance from the best performing mills in the nonintegrated-tissue papers subcategory for both product sectors in the nonintegrated-lightweight papers subcategory. EPA applied the average percentage reductions beyond BPT for the nonintegrated-tissue papers subcategory (21.6 percent for BOD5 and 31.9 percent for TSS) to BPT final effluent levels for this subcategory. As explained in the development document supporting the January 1981 proposed regulations, EPA has determined that the characteristics and treatability of wastewaters discharged from mills in the nonintegrated lightweight papers subcategory and the nonintegrated-tissue papers subcategory are similar.

TABLE III-58
DISCHARGE MONITORING REPORT DATA
NONINTEGRATED - TISSUE PAPERS SUBCATEGORY

		Final Effluent Long-Term Average Levels				Number Of Months Data		
Mill Number	Grade Change/ Day (a)	Flow kl/kkg (kgal/t)	BOD5 kg/kkg (lb/t)	TSS kg/kkg (lb/t)	Start Date	Flow	BOD5	TSS
040006	U	91.9 (22.03)	4.9 (9.70)	2.6 (5.28)	08/79	21	22	22
090001(b)(c)	O	70.8 (16.96)	1.6 (3.12)	1.0 (1.97)	07/77	24	42	42
090005(b)(c)(d)	O	11.4 (2.73)	0.2 (0.42)	0.2 (0.45)	09/77	29	29	29
090007(b)(c)	-	92.7 (22.21)	0.2 (0.47)	0.6 (1.28)	07/77	36	36	36
090008(b)	O	57.3 (13.74)	2.2 (4.44)	0.7 (1.31)	07/77	47	47	47
090011(b)(d)	-	53.1 (12.72)	2.4 (4.88)	1.2 (2.30)	07/77	28	28	27
090013(b)	U	29.5 (7.06)	1.1 (2.28)	0.6 (1.24)	08/77	40	40	40
090019	U	80.4 (19.26)	2.9 (5.82)	3.3 (6.54)	07/77	46	46	46
090022(b)	-	62.1 (14.87)	3.0 (6.09)	2.7 (5.46)	07/77	20	28	26
090024(b)	O	81.8 (19.61)	1.0 (1.90)	0.7 (1.41)	07/77	22	22	22
090028(b)(d)	U	91.8 (22.00)	2.2 (4.34)	1.9 (3.82)	01/78	36	36	36
090031	-/W	97.9 (23.47)	2.0 (4.01)	3.2 (6.41)	07/77	36	36	36
090032	-	133.9 (32.08)	2.4 (4.76)	3.4 (6.88)	08/77	26	44	44
555555	U	73.3 (17.57)	4.9 (9.79)	7.6 (15.19)	04/79	21	21	21
BPT-Final Effluent Levels		96.0 (22.9)	3.5 (7.0)	2.9 (5.7)				
Average of Mills Attaining BPT BOD5 and TSS								
-All mills			1.6 (3.10)	1.1 (2.14)				
-No waste significant grade changes per day			1.6 (3.17)	0.68 (1.36)				
-Less than one waste significant grade change per day			2.7 (5.49)	1.9 (3.88)				

(a) - = <1; -/W = <1/week; U = unknown.

(b) TSS and BOD5 are less than or equal to BPT.

(c) Data not included in the average because the mill employs biological treatment.

(d) Mill is now closed.

The Agency, therefore, believes that mills in both sectors of the nonintegrated-lightweight papers subcategory will be able to attain the BCT Option 4 long-term average final effluent levels. As shown on Table III-59, BCT Option 4 flow and final effluent BOD5 and TSS levels for the lightweight papers sector are 203.2 kl/kkg (48.7 kgal/t), 5.8 kg/kkg (11.6 lb/t), and 4.1 kg/kkg (8.2 lb/t). BCT Option 4 flow and final effluent BOD5 and TSS levels for the lightweight electrical papers are 320.9 kl/kkg (76.9 kgal/t), 9.1 kg/kkg (18.3 lb/t), and 6.4 kg/kkg (12.9 lb/t), respectively.

Nonintegrated-Filter and Nonwoven Papers - EPA based BCT Option 4 effluent levels for the nonintegrated-filter and nonwoven papers subcategory on the transfer of performance from the best performing mills in the nonintegrated-tissue papers subcategory. EPA applied the average percent reductions below BPT for the nonintegrated-tissue papers subcategory (21.6 percent for BOD5 and 31.9 percent for TSS) to the BPT final effluent levels for this subcategory. As explained in the development document supporting the January 1981 proposed rules, EPA determined that the characteristics and treatability of wastewaters discharged from mills in the nonintegrated-filter and nonwoven papers subcategory will be able to attain the BCT Option 4 long-term average discharge levels.(1) Available effluent data for mills in this subcategory are presented in Table III-60. BCT Option 4 flow and final effluent BOD5 and TSS levels for the nonintegrated-filter and nonwoven papers subcategory are 250.0 kl/kkg (59.9 kgal/t), 7.1 kg/kkg (14.2 lb/t) and 5.0 kg/kkg (10.0 lb/t), respectively.

Nonintegrated-Paperboard - EPA based BCT Option 4 effluent levels on the transfer of performance from the best performing mills in the nonintegrated-tissue papers subcategory for this subcategory. EPA applied the average percent reductions below BPT for the nonintegrated-tissue papers subcategory (21.6 percent for BOD5 and 31.9 percent for TSS) to the final BPT limitations for this subcategory. As explained in the development document supporting the January 1981 proposed rules, EPA determined that the characteristics and treatability of wastewaters discharged from mills in the nonintegrated-paperboard subcategory and nonintegrated-tissue papers subcategory are similar. Therefore, the Agency believes that mills in the nonintegrated-paperboard subcategory will be able to attain the BCT Option 4 long-term average discharge levels. BCT Option 4 flow and BOD5 and TSS levels for the nonintegrated-paperboard subcategory are 53.8 kl/kkg (12.9 kgal/t), 1.5 kg/kkg (3.1 lb/t), and 1.1 kg/kkg (2.2 lb/t), respectively. Available effluent data for mills in this subcategory are presented in Table III-61.

The BCT Option 4 long-term average final effluent levels, developed as described above, are presented in Table III-62.

TABLE III-59
DISCHARGE MONITORING REPORT DATA
NONINTEGRATED - LIGHTWEIGHT PAPERS SUBCATEGORY[1]

Mill Number	Final Effluent Long-Term Average Levels			Start Date	Number Of Months Data		
	Flow	BOD5	TSS		Flow	BOD5	TSS
	kl/kkg (kgal/t)	kg/kkg (lb/t)	kg/kkg (lb/t)				
Lightweight							
080021(a)(d)	66.0 (15.81)	0.9 (1.74)	0.5 (1.08)	07/77	34	34	34
080022(d)	82.0 (19.65)	1.3 (2.63)	2.1 (4.15)	01/78	31	31	29
080024(d)	45.2 (10.82)	0.6 (1.27)	0.7 (1.48)	01/78	23	23	23
090003(b)(d)	63.4 (15.20)	3.1 (6.15)	2.0 (3.90)	08/77	41	43	43
090015(a)(d)	117.6 (28.18)	2.3 (4.51)	2.1 (4.26)	11/78	30	30	30
105013(a)	319.9 (76.65)	7.2 (14.49)	8.9 (17.72)	07/77	34	36	36
105020(d)	189.9 (45.51)	1.3 (2.65)	1.8 (3.59)	01/78	37	37	37
BPT-Final Effluent Levels	203.2 (48.7)	7.4 (14.7)	6.0 (12.0)				
Electrical							
105003(c)(d)	417.3(100.00)	4.6 (9.17)	3.4 (6.78)	01/78	23	23	23
105018(a)(d)	678.1(162.49)	3.7 (7.41)	3.1 (6.17)	07/77	41	44	44
BPT-Final Effluent Levels	320.9 (76.9)	11.6 (23.2)	9.5 (19.0)				

(a) This mill has biological treatment.
(b) This mill has no external treatment.
(c) Mill is now closed.
(d) TSS and BOD5 are less than or equal to BPT.

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[1] Option 1 levels are based on transfer of technology from Nonintegrated-Tissue Papers Subcategory.

TABLE III-60
DISCHARGE MONITORING REPORT DATA
NONINTEGRATED - FILTER AND NONWOVEN PAPERS SUBCATEGORY[1]

	Final Effluent Long-Term Average Levels						
Mill Number	Flow kl/kkg (kgal/t)	BOD5 kg/kkg (lb/t)	TSS kg/kkg (lb/t)	Start Date	Number Of Months Data Flow	Number Of Months Data BOD5	Number Of Months Data TSS
105033(a)(b)	170.5 (40.86)	1.8 (3.56)	1.1 (2.18)	07/77	43	44	44
105034(a)(b)	204.3 (48.95)	3.8 (7.51)	2.8 (5.63)	07/77	39	44	44
105051(b)	168.1 (40.28)	1.4 (2.85)	2.2 (4.33)	07/77	12	12	12
105055(a)(b)	249.9 (59.88)	1.5 (2.99)	2.9 (5.77)	12/77	33	33	33
BPT-Final Effluent Levels	250.0 (59.9)	9.1 (18.1)	7.4 (14.8)				

(a) This mill has biological treatment.
(b) TSS and BOD5 are less than or equal to BPT.

[1] Option 1 levels are based on transfer of technology from Nonintegrated-Tissue Papers subcategory.

TABLE III-61
DISCHARGE MONITORING REPORT DATA
NONINTEGRATED - PAPERBOARD SUBCATEGORY[1]

Mill Number	Final Effluent Long-Term Average Levels Flow kl/kkg (kgal/t)	 BOD5 kg/kkg (lb/t)	 TSS kg/kkg (lb/t)	Start Date	Number Of Months Data Flow	 BOD5	 TSS
085001(a)(d)	19.8 (4.75)	0.7 (1.43)	0.4 (0.72)	07/77	44	45	44
085007	167.9 (40.24)	1.5 (3.09)	2.2 (4.45)	07/77	46	43	40
105002	238.0 (57.04)	4.8 (9.66)	2.2 (4.30)	07/77	30	28	28
105048(b)(d)	26.1 (6.26)	0.3 (0.59)	0.2 (0.49)	01/78	33	32	33
105049(b)(c)	51.3 (12.30)	5.5 (10.99)	0.5 (1.04)	03/78	11	11	11
110021(a)	57.2 (13.70)	1.5 (3.03)	2.7 (5.34)	07/77	41	40	40
BPT-Final Effluent Levels	53.8 (12.9)	2.0 (3.9)	1.6 (3.2)				

(a) This mill has biological treatment.
(b) This mill has no external treatment.
(c) This mill now discharges to a POTW.
(d) TSS and BOD5 are less than or equal to BPT.

[1] Option 1 levels are based on transfer of technology from Nonintegrated-Tissue Papers subcategory.

TABLE III-62

BCT OPTION 4
LONG-TERM AVERAGE DISCHARGE CHARACTERISTICS

	Flow		BOD5		TSS	
	kl/kkg	(kgal/t)	kg/kkg	(lb/t)	kg/kkg	(lb/t)
Integrated Segment						
Dissolving Kraft	229.9	(55.1)	4.6	(9.2)	6.5	(13.1)
Market Bleached Kraft	173.6	(41.6)	3.3	(6.6)	5.7	(11.4)
BCT Bleached Kraft	147.7	(35.4)	2.6	(5.2)	4.3	(8.6)
Alkaline-Fine[1]	128.9	(30.9)	1.9	(3.9)	3.2	(6.4)
Unbleached Kraft						
o Linerboard	52.6	(12.6)	1.2	(2.4)	2.3	(4.5)
o Bag	52.6	(12.6)	1.5	(3.1)	2.7	(5.4)
Semi-Chemical	43.0	(10.3)	1.2	(2.4)	2.2	(4.4)
Unbleached Kraft and Semi-Chemical	58.4	(14.0)	1.4	(2.7)	2.4	(4.7)
Dissolving Sulfite Pulp						
o Nitration	275.4	(66.0)	7.1	(14.1)	12.7	(25.4)
o Viscose	275.4	(66.0)	7.6	(15.1)	12.7	(25.4)
o Cellophane	275.4	(66.0)	8.2	(16.4)	12.7	(25.4)
o Acetate	302.1	(72.4)	10.4	(20.8)	14.0	(27.9)
Papergrade Sulfite[2]	(3)	(3)	(3)	(3)	(3)	(3)
Groundwood-Thermo-Mechanical	--	--	--	--	--	--
Groundwood-CMN Papers	99.3	(23.8)	1.5	(3.0)	2.2	(4.4)
Groundwood-Fine Papers	91.4	(21.9)	1.4	(2.7)	2.0	(4.0)
Secondary Fibers Segment						
Deink						
o Fine Papers	101.8	(24.4)	2.5	(5.0)	3.3	(7.6)
o Tissue Papers	101.8	(24.4)	3.2	(6.5)	4.2	(8.3)
o Newsprint	--	--	--	--	--	--
Tissue From Wastepaper	68.0	(16.3)	1.3	(2.6)	2.8	(5.7)
Paperboard From Wastepaper						
o Corrugating Medium Furnish	13.4	(3.2)	1.1	(2.2)	1.2	(2.4)
o Noncorrugating Medium Furnish	13.4	(3.2)	0.73	(1.5)	0.97	(1.9)
Wastepaper-Molded Products	23.8	(5.7)	0.60	(1.2)	1.1	(2.3)
Builders' Paper and Roofing Felt	11.3	(2.7)	0.53	(1.1)	0.76	(1.5)
Nonintegrated Segment						
Nonintegrated-Fine Papers						
o Wood Fiber Furnish	63.4	(15.2)	1.4	(2.8)	1.6	(3.2)
o Cotton Fiber Furnish	176.5	(42.3)	3.0	(6.0)	3.5	(7.0)
Nonintegrated-Tissue Papers	95.6	(22.9)	2.7	(5.5)	1.9	(3.9)
Nonintegrated-Lightweight Papers						
o Lightweight	203.2	(48.7)	5.8	(11.6)	4.1	(8.2)
o Electrical	320.9	(76.9)	9.1	(18.3)	6.4	(12.9)
Nonintegrated-Filter and Nonwoven Papers	250.0	(59.9)	7.1	(14.2)	5.0	(10.0)
Nonintegrated-Paperboard	53.8	(12.9)	1.5	(3.1)	1.1	(2.2)

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[1] Includes Fine Bleached Kraft and Soda subcategories.

[2] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories.

[3] BCT Option 4 effluent characteristics vary with the percent sulfite pulp in the final product. The following equations can be used to obtain annual average effluent characteristics for Papergrade Sulfite mills:

Flow (kl/kkg) $= 41.93 + 1.890x$
BOD5 (kg/kkg) $= 0.86 + 0.047x$
TSS (kg/kkg) $= 1.35 + 0.069x$

where x equals the percent sulfite pulp produced on-site in the final product.

Attainment of BCT Option 4

Table III-63 summarizes the number of mills attaining BPT and BCT Option 4 long-term average final effluent levels and the number of direct discharging mills in each subcategory for which data were available. BCT Option 4 limits are attained at 37 percent of the mills in the integrated segment, at 63 percent of the mills in the secondary fibers segment, and at 74 percent of the mills in the nonintegrated segment. Percent reductions required to attain BCT Option 4 BOD5 final effluent characteristics are shown in Table III-64.

EPA compared the BCT Option 4 RWLs shown in Table III-39, the BCT Option 4 final effluent levels presented in Table III-62, and the BPT RWLs and final effluent levels. The Agency found that, for all subcategories, compliance with BCT Option 4 final effluent loads would require a higher BOD5 percent reduction than required by compliance with BPT effluent limitations. Therefore, the end-of-pipe systems that form the basis of BCT Option 4 must be more efficient in removing BOD5 than the systems that form the basis of BPT effluent limitations.

For all mills used to develop BCT Option 4 long-term average final effluent levels, EPA compared BOD5 final effluent levels to BOD5 RWLs to determine if the higher percent reductions associated with BCT Option 4 are demonstrated in this industry. The raw waste and final effluent data presented in this section were used; however, in some cases, more recent RWL data were available so these data were used in the analysis. The percent reductions in BOD5 attained at actual mills were then compared to those that form the basis of BCT Option 4, and are presented in Table III-65. To complete this assessment, EPA investigated eight major industry sectors: bleached kraft, unbleached kraft/semi-chemical, sulfite, groundwood, deink, other secondary fibers, nonintegrated-fine papers, and other nonintegrated. As shown in Tables III-63 and 65 and as discussed below, mills in every major sector achieve the percent reductions of BOD5 that form the basis of BCT Option 4. The subcategories in each sector have similar waste characteristics and waste treatability. EPA has determined that all mills representative of subcategories in a sector are capable of achieving equivalent reductions.

In the bleached kraft sector, the BOD5 reductions (or the BOD5 removal from BCT Option 4 RWL to BCT Option 4 final effluent levels) ranged from 91 to 94 percent. A BOD5 reduction within this range occurs at mills 030010, 030030, 030032, 030046, and 032002. BOD5 reductions of greater than 94 percent are being attained at mills 030020, 030027, and 777777.

In the unbleached kraft and semi-chemical sector, BOD5 reduction ranges from 93 to 95 percent. A BOD5 reductions within this range occurs at mills 010008, 015004, and 060004 and at mills 010020 and 010025 where oxidation ponds are used. A BOD5 reduction of greater than 95 percent is being attained at mill 020003.

TABLE III-63

NUMBER OF FACILITIES THAT ATTAIN BPT AND BCT OPTION 4 FINAL EFFLUENT CHARACTERISTICS

	Mills with Available Data	Mills Attaining BPT F.E. Levels(a)	Mills Attaining BCT Option 4 F.E. Levels(a)
Integrated Segment			
Dissolving Kraft	3	1	1
Market Bleached Kraft	10	7	2
BCT Bleached Kraft	9	5	1
Alkaline-Fine[1]	16	6	2
Unbleached Kraft			
o Linerboard	15	7	2
o Bag	7	3	1
Semi-Chemical	15	4	2
Unbleached Kraft and Semi-Chemical	8	2	1
Dissolving Sulfite Pulp			
o Nitration	0	0	0
o Viscose	2	0	0
o Cellophane	1	0	0
o Acetate	2	0	0
Papergrade Sulfite[2]	12	4	2
Groundwood-Thermo-Mechanical			
Groundwood-CMN Papers	2	1	1
Groundwood-Fine Papers	7	6	2
Secondary Fibers Segment			
Deink			
o Fine Papers	3	2	0
o Tissue Papers	11	7	6
o Newsprint			
Tissue From Wastepaper	9	7	1
Paperboard From Wastepaper			
o Corrugating Medium Furnish	3	2	1
o Noncorrugating Medium Furnish	36	23	18
Wastepaper-Molded Products	4	1	0
Builders' Paper and Roofing Felt	5	4	3
Nonintegrated Segment			
Nonintegrated-Fine Papers			
o Wood Fiber Furnish	12	5	2
o Cotton Fiber Furnish	2	1	0
Nonintegrated-Tissue Papers[3]	11	6	5
Nonintegrated-Lightweight Papers[3]			
o Lightweight	4	4	4
o Electrical	1	1	1
Nonintegrated-Filter[3] and Nonwoven Papers[3]	1	1	1
Nonintegrated-Paperboard[3]	4	1	1

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[1] Includes Fine Bleached Kraft and Soda subcategories.

[2] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories.

[3] Includes only mills that do not use secondary treatment.

(a) F.E. = Final Effluent

TABLE III-64

PERCENT REDUCTIONS
REQUIRED TO ATTAIN BCT OPTION 4 BOD_5
FINAL EFFLUENT CHARACTERISTICS
FROM BCT OPTION 4 BOD_5 RAW WASTE LOADS

	Percent Reduction*
Integrated Segment	
Dissolving Kraft	93
Market Bleached Kraft	91
BCT Bleached Kraft	93
Alkaline-Fine[1]	94
Unbleached Kraft	
o Linerboard	93
o Bag	94
Semi-Chemical	95
Unbleached Kraft and Semi-Chemical	93
Dissolving Sulfite Pulp	
o Nitration	95
o Viscose	95
o Cellophane	96
o Acetate	96
Papergrade Sulfite[2]	92-96
Groundwood-Thermo-Mechanical	--
Groundwood-CMN Papers	91
Groundwood-Fine Papers	92
Secondary Fibers Segment	
Deink	
o Fine Papers	97
o Tissue Papers	96
o Newsprint	--
Tissue From Wastepaper	87[3]
Paperboard From Wastepaper	
o Corrugating Medium Furnish	95[3]
o Noncorrugating Medium Furnish	93[3]
Wastepaper-Molded Products	89[3]
Builders' Paper and Roofing Felt	93[3]
Nonintegrated Segment	
Nonintegrated-Fine Papers	
o Wood Fiber Furnish	87
o Cotton Fiber Furnish	87
Nonintegrated-Tissue Papers	76
Nonintegrated-Lightweight Papers	
o Lightweight	73
o Electrical	58
Nonintegrated-Filter and Nonwoven Papers	42
Nonintegrated-Paperboard	85

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[1] Includes Fine Bleached Kraft and Soda subcategories.

[2] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories. The percent reduction is a function of the percent sulfite pulp manufactured on-site.

[3] BCT Option 4 is identical to BCT Option 1 for this subcategory, and reductions are those predicted by equation relating biological treatment system influent BOD_5 to effluent BOD_5.

*Percent reduction
= [raw waste load (lb/t) - final effluent (lb/t)] x 100/raw waste load (lb/t)

TABLE III-65

PERCENT BOD5 REDUCTIONS ATTAINED AT SOME MILLS MEETING BPT BOD5 AND TSS FINAL EFFLUENT LEVELS

Sector/Mill Number	Percent Reductions to attain BCT Option 4 BOD5 F.E. Levels(a)	Raw Waste Load BOD5(b) (lb/t)	Final Effluent BOD5(b) (lb/t)	Percent Reduction From Raw Waste BOD5 to Final Effluent BOD5
Bleached Kraft	91-94			
030010		74.3	4.9	93
030020		51.0	2.7	95
030027		46.9(1)	1.3	97
030030		88.1	5.4	94
030032		66.1(1)	5.1	92
030046		62.3	4.1	93
032002		78.7	7.5	91
777777		71.8(2)	3.1	96
Unbleached Kraft and Semi-Chemical	93-95			
010008		37.6	2.0	95
010020(c)		41.0	2.2	95
010025(c)		27.8	1.1	96
015004		34.2	1.7	95
020003		50.5	0.7	99
060004		37.4(1)	2.5	93
Sulfite	92-96			
040009(d)		(3)	(3)	94(3)
040019		93.1(4)	3.92(4)	96
Groundwood	91-92			
052003		24.3	1.6	93
052007		38.8(5)	1.9	95
052008		20.1	0.9	96
052014		24.0	0.6	98
054014		33.6	2.5	93
054015		42.7	2.5	94
070001		38.0	3.2	92
Deink	96-97			
140007		125.5(1)	4.4	97
140014		179.7(5)	5.8	97
140021		284.3(6)	4.4	99
140030		143.0(7)	3.9	97
Other Secondary Fiber	87-95			
085004		44.7	3.6	92
100005		28.4	3.7	87
110001		25.0	0.3	99
110025		38.6	1.7	96
110031		7.1(5)	0.3	96
110043		23.5(5)	1.6	93
110052		18.1	0.8	96
110057		35.0	1.7	95
110062		22.9	1.1	95
110069		14.8	0.5	97
110110		22.4	0.4	98
120004		10.9	0.3	97
Nonintegrated-Fine Papers	87			
080041		29.8	3.4	89
080046		27.6	2.2	92

TABLE III-65 (cont.)

Sector/Mill Number	Percent Reductions to attain BCT Option 4 BOD5 F.E. Levels(a)	Raw Waste Load BOD5(b) (lb/t)	Final Effluent BOD5(b) (lb/t)	Percent Reduction From Raw Waste BOD5 to Final Effluent BOD5
Other Nonintegrated	42-85			
090008		30.6	4.4	86
090013		12.6	2.3	82
090022		18.2	6.1	66
105020		16.5	2.7	84
105051		9.9	2.9	71

(a) These represent the range of the percent reductions required to attain the subcategory BCT Option 4 final effluent BOD5 levels from BCT Option 4 raw waste loads.

Percent reduction = [raw waste BOD5 (lb/t) final effluent BOD5 (lb/t)]
x 100/raw waste BOD5 (lb/t)

(b) The sources of the raw waste load data and the final effluent data are the 308 Survey and long-term average BOD5 levels from the Discharge Monitoring Reports respectively except as noted below:

(1) Data are from the Supplemental Data Request Program.
(2) One year raw waste data obtained from mill representatives.
(3) The percent reduction shown represents the reduction from BOD5 RWL for the papergrade sulfite mill (040009) (97.7 lb/t x 566 t/d = 55,298 lb/d) to the total final effluent BOD5 load from the joint treatment system (mills 040009 and 030051) (2.95 lb/t x 1173 t/d = 3460 lb/d).
(4) The percent reduction is based on influent to and effluent from the biological treatment system. Data are from the Supplemental Data Request Program.
(5) Data are from the Verification Data Request Program.
(6) Data are from Long-term Sampling Program.
(7) Data are from Discharge Monitoring Reports.

(c) The treatment system used at this mill is a storage oxidation basin.

(d) This mill shares a joint treatment system with a fine bleached kraft mill. Approximately 40 percent of the combined output of the two mills is sulfite pulp. Prorated BPT was calculated for the combined mills and it was determined that the treatment system attained BPT levels.

In the sulfite sector, BOD5 reductions range from 92 to 96 percent. A 96 percent BOD5 reduction occurs at mill 040019 where only pulp mill wastes are biologically treated. The BPT long-term average BOD5 effluent level is now attained at mills 040016 and 040017; however, the BPT long-term average TSS effluent level is exceeded. At mills 040016 and 040017, BOD5 percent reductions of between 94 and 95 percent occur. Also, mill 040009, a papergrade sulfite mill, shares a joint treatment system with a bleached kraft mill. About 60 percent of the BOD5 RWL is associated with the papergrade sulfite operations. At mill 040009, a BOD5 reduction of over 98 percent occurs.

In the groundwood sector, BOD5 reduction ranges from 91 to 92 percent. A BOD5 reduction occurs within this range at mill 054014. BOD5 reductions of greater than 92 percent occur at mills 052001, 052007, 052008, 052014, 054015, and 070001.

In the deink sector, BOD5 reductions range from 96 to 97 percent. A BOD5 reduction within this range occurs at mills 140007, 140014, 140019, and 140030. A BOD5 reduction of 99 percent occurs at mill 140021.

In the other secondary fibers sector subcategories, BOD5 reductions range from 87 to 95 percent. A BOD5 reduction within this range occurs at mills 085004, 100005, 110043, 110057, and 110062. A BOD5 reduction of greater than 95 percent occurs at mills 110001, 110025, 110031, 110052, 110069, 110110, and 120004.

In the nonintegrated-fine papers sector, the BOD5 reduction is 87 percent. BOD5 reductions of at least 87 percent occur at mills 080041 and 080046.

In the other nonintegrated sector subcategories, the BOD5 reductions range from 42 to 85 percent. A BOD5 reduction within this range occurs at mills 090013, 090022, 105020, and 105051. A BOD5 percent reduction of greater than 85 percent occurs at mill 090008.

As shown above, end-of-pipe biological treatment is capable of attaining the percent reductions in BOD5 that form the basis of BCT Option 4 in all subcategory sectors where biological treatment is the technology basis of BPT effluent limitations. Both the activated sludge process and aerated stabilization basin systems are capable of attaining these reductions. In northern climates, available data show that the activated sludge process is superior in its ability to control pulp, paper, and paperboard industry discharges (see development document supporting the January 1981 proposed regulations). In the nonintegrated subcategories where primary treatment is the basis of BPT effluent limitations, primary treatment is also capable of attaining the BOD5 reductions required by BCT Option 4.

Some commenters on the January 1981 proposed regulations expressed concern that few existing mills in the integrated segment were attaining the proposed BCT Option 4 levels. These commenters stated that EPA had overstated the capability of biological treatment to reduce BOD5 RWLs in this segment. As discussed above, biological treatment systems now employed in the integrated segment are capable of reducing BOD5 to the extent required by BCT Option 4. Because the biological treatment systems that are the basis of BCT Option 4 must achieve a higher BOD5 percent reduction than that required by BPT technology, the Agency conducted further investigations to ensure that these systems have been sized properly to ensure that the higher BOD5 reductions could be attained at all mills.

In the development document supporting the January 1981 proposed rules, EPA published the design criteria for end-of-pipe biological treatment systems believed to be capable of attaining the proposed BCT Option 4 effluent levels.(1) These design criteria are identical to the BCT Option 4 design criteria in Table III-66 of this document. This table also presents design criteria for aerated stabilization basins and extended aeration activated sludge systems that EPA believes are equivalent in pollutant removal capability to the conventional activated sludge systems that form the basis of BCT Option 4 (see Section IX of the development document supporting the proposed rules).(1) As shown, these systems are considerably larger than those that form the basis of BPT effluent limitations.

Table III-67 compares EPA's design criteria to the actual design criteria for treatment systems that achieve the percent reductions of BOD5 required for meeting BCT Option 4 levels. As shown, conventional activated sludge systems (and the equivalent aerated stabilization basins and extended aeration activated sludge systems) that form the basis of BCT Option 4 are larger than the systems generally employed at actual mills attaining the required BCT Option 4 percent reductions. Therefore, the larger end-of-pipe treatment systems that form the basis of BCT Option 4 for the integrated segment are capable of attaining the BOD5 reductions that are required by BCT Option 4.

In summary, the percent BOD5 reductions that form the basis of BCT Option 4 are being attained at mills in each subcategory or at mills in related subcategories where wastewaters have similar characteristics and treatability. These reductions are being attained by the use of treatment systems that are even smaller than those that form the basis of BCT Option 4. These larger systems have not been chosen for use by mills in many subcategories of the pulp, paper, and paperboard industry, but the technology is readily available for application at all mills. Because (a) the upgrade of in-place treatment systems can be readily designed, constructed, and operated at mills in every subcategory and (b) the wastewater and operating characteristics remain unchanged, EPA has determined that all mills in every subcategory will be capable of attaining BCT Option 4 limitations by use of expanded end-of-pipe treatment systems.

TABLE III-66

A COMPARISON OF
BCT OPTION 4 DESIGN CRITERIA
TO BPT DESIGN CRITERIA

Activated Sludge	BPT	BCT Option 4
Primary clarification (cu m/d/sq m)	24	20
Equalization (hours)	12	12
Aeration Basin		
o Detention Time (hours)	8	12
o Organic Loading (kg BOD5/d/cu m)	0.8	0.5
Aeration (kg BOD5/d/HP)	19	11.2
Secondary clarification (cu m/d/sq m)	20	16
Extended Aeration		
Primary clarification (cu m/d/sq m)	24	20
Equalization (hours)	12	12
Aeration Basin		
o Detention Time (hours)	30	48
o Organic Loading (kg BOD5/d/cu m)	0.3-0.6	0.2
Aeration (kg BOD5/d/HP)	19	11.2
Secondary Clarification (cu m/d/sq m)	20	16
Aerated Stabilization Basin		
Primary Clarification (cu m/d/sq m)	24	20
Aeration Basin		
o Detention Time (days)	13	13
o Organic Loading (kg BOD5/d/1000 cu m)	18.4	18.4
Aeration		
o Organic (kg BOD5/d/HP)	15.3	15.3
o Mixing (HP/1000 cu m)	(a)	2.6
Settling (days)	1	10

(a) Aerator mixing was not considered in BPT design criteria.

TABLE III-67

A COMPARISON OF BCT OPTION 4 DESIGN CRITERIA TO CRITERIA USED AT INTEGRATED MILLS WHERE BOD5 REDUCTIONS COMPARABLE TO THOSE REQUIRED TO ATTAIN BCT OPTION 4 ARE ACHIEVED

	BCT Option 4 Design Criteria	Actual Mill			
Activated Sludge		Average	Median	Minimum	Maximum
Primary clarification (cu m/d/sq m)	20	20	20	10	28
Aeration Basin					
o Detention Time (hours)	12.0	7.8	6.9	2.9	16.4
o Organic Loading (kg BOD5/d/cu m)	0.5	0.9	0.9	0.6	1.2
Aeration (kg BOD5/HP)	11.2	17.0	14.9	11.1	29.4
Secondary clarification (cu m/d/sq m)	16	18	17	15	23
Extended Aeration					
Primary clarification (cu m/d/sq m)	20	35	28	12	63
Aeration Basin					
o Detention Time (hours)	48	45.2	29.4	19.0	117.6
o Organic Loading (kg BOD5/d/cu m)	0.2	0.3	0.2	0.1	1.1
Aeration (kg BOD5/HP)	11.2	17.5	13.9	7.3	32.8
Secondary clarification (cu m/d/sq m)	16	25	24	6	43
Aerated Stabilization Basin					
Primary clarification (cu m/d/sq m)	20	19	20	8	25
Aeration Basin					
o Detention Time (days)	13	9.7	9.7	0.9	15.2
o Organic Loading (kg BOD5/d/cu m)	18.4	30.5	22.1	13.2	94.9
Aeration					
o Organic Loading (kg BOD5/HP)	15.3	16.7	16.2	11.9	24.0
o Mixing (HP/1000 cu m)	2.6	2.0	1.3	0.6	6.6
Settling (days)	10	9.9	9.9	0.2	22.2

CONVENTIONAL POLLUTANT VARIABILITY ANALYSIS

Pollutant quantities discharged from a wastewater treatment system vary. EPA accounts for this variability in deriving limitations controlling wastewater discharges. The statistical procedures employed in analyzing variability for the conventional pollutants, BOD_5 and TSS, regulated under BCT for the pulp, paper, and paperboard industry are described below.

Effluent Limitations Guidelines

An effluent limitation is an upper bound on the amount of pollutant discharge allowed per day or average of 30 days. The limitations are determined by calculating the product of two numbers which may be derived from effluent data: one is referred to as a variability factor and the other is referred to as a long-term average. Two types of variability factors are derived for the guidelines: a daily maximum factor and a 30-day maximum factor. The daily maximum factor is the ratio of (a) a value that would be exceeded rarely by the daily pollutant discharge to (b) the long-term average daily discharge. The 30-day maximum factor is the ratio of (a) a value that would be exceeded rarely by the average of 30 daily discharge measurements to (b) the long-term average daily discharge. The long-term average daily discharge quantity is an expression of the long-term performance of the treatment or discharge process in units of average daily kilograms (pounds) of pollutant discharged. Given a daily maximum variability factor for a pollutant (denoted by VF) and a long-term average for the same pollutant (denoted by LTA), the daily limitation is the product of the variability factor and the long-term average (VF x LTA). Similarly, given a 30-day maximum variability (VF_{30}), the limit for the average of 30 daily observations is VF_{30} x LTA.

Daily Maximum Variability Factors

Previously, in this industry, the daily maximum variability factor has been defined as the ratio of an estimated 99th percentile of the distribution of daily pollutant discharge values to the estimated long-term average daily pollutant discharge. The 99th percentile of daily pollutant discharge represents a pollutant discharge value below which fall 99 percent of all pollutant discharge values. Estimates of the 99th percentile of daily pollutant discharge distribution may be calculated from available effluent data. Percentiles may be estimated using either a parametric or nonparametric approach. To use a parametric approach, a distribution with a known functional form is fit to the data. Distributions such as normal, lognormal, and three-parameter lognormal distributions have been used for past guidelines development. If a distribution describes the data adequately, a 99th percentile can be calculated through the use of the known functional form of the assumed distribution.

Nonparametric methods may also be used to estimate distribution percentiles. Such methods do not require that the particular form of the underlying distribution be known, and make no restrictive assumptions about the distributional form of the data. Nonparametric methods are discussed in many texts. See, for example, J.D. Gibbons, Nonparametric Statistical Inference, McGraw-Hill (1971).(15) EPA has applied nonparametric methods to pulp, paper, and paperboard industry effluent data to obtain 50 percent confidence level (or tolerance level) estimates of the 99th percentile of the distribution of daily pollutant discharge. An estimate of the 99th percentile was determined such that the probability that the estimate (which is of the form: the rth largest of n measurements) is greater than or equal to the 99th percentile of the daily pollutant discharge (denoted as $K_{.99}$) is no less than 0.5. That is, n daily pollutant discharge values were obtained and ordered from smallest to largest in value. The rth smallest pollutant discharge value (where r is less than or equal to n), denoted by X(r), is chosen such that the probability that X(r) is greater than or equal to $K_{.99}$ is at least 0.5 (i.e., $P[X(r) \geq K_{.99}] > 0.05$). Using this approach, the value of r is determined such that

$$P[X_{(r)} > K_{.99}] = 1- P[X_{(r)} < K_{.99}] = 1- \sum_{i=r}^{n} \binom{n}{i} p^{i} (1-p)^{n-i} > 0.5$$

where $p = .99$

and $\binom{n}{i} = \frac{n!}{i!\,(n-i)!}$

The estimate is interpreted as the value below which 99 percent of the values of a future sample of size n will fall with a probability of at least 0.5.

Analysis of Daily Pollutant Discharge Values to Determine Daily Maximum Variability Factors

Daily measurements for the conventional pollutants, BOD5 and TSS, were submitted by mill representatives. Values for facilities employing primary and/or biological treatment were obtained through the supplemental data request program. Values for facilities employing chemically assisted clarification were obtained through the supplemental data request program and the verification sampling program. These values were used to calculate daily maximum variability factors and 30-day maximum variability factors.

Initially, a parametric approach was considered to estimate the 99th percentile of daily pollutant discharge values. Mill-specific daily pollutant discharge values for BOD5 and TSS were fit to hypothesized normal and lognormal distributions. Kolmogorov-Smirnov goodness-of-fit tests and frequency histograms were then performed to assess whether mill-specific sets of daily pollutant values could be adequately described by the normal or lognormal distributions. The goodness-of-fit tests indicated that, in general, neither the normal nor lognormal distribution adequately represent the mill-specific daily pollutant discharge values of BOD_5 and TSS. Because of these results, EPA decided to use nonparametric estimates of the 99th percentile of the daily data.

The 50 percent tolerance level criterion described above was used to estimate the 99th percentile. Mill-specific daily maximum variability factors were determined by calculating the ratio of the 99th percentile estimates to the average of the daily discharge values. The effects of daily dependence were examined using a time series model that was developed for the timber products point source category (see reference 16 Final Development Document for Effluent Limitations Guidelines and Standards for the Timber Products Point Source Category, U.S. EPA, Washington, D.C., January 1981)). The results show that maximum day variability factors are relatively insensitive to daily dependence and that the nonparametric methods used yield representative variability factors for data examined in this study.

The conclusions above are supported by additional analyses conducted by the Agency. Each daily value was compared to the corresponding mill-specific 99th percentile estimate on a mill-specific basis. Table III-68 displays the aggregate results of comparing each daily value to its corresponding 99th percentile estimate of the daily maximum discharges of BOD_5 and TSS. The percentage of daily values exceeding the 99th percentile estimate is substantially the same as the expected one percent. Table III-69 displays mill-specific values for maximum day variability factors for BOD_5 and TSS, obtained by dividing the 99th percentile estimates by the long-term average pollutant values.

30-Day Maximum Variability Factors

The approach for deriving 30-day maximum variability factors is suggested by a statistical result known as the Central Limit Theorem. This theorem states that the distribution of a mean of a sample of size n drawn from any one of a large class of different distributional forms will be approximately normally distributed. For practical purposes, the normal distribution provides a good approximation to the distribution of the sample mean for samples as small as 25 or 30 (see reference 17, Miller and Freund, Probability and Statistics for Engineers, Prentice-Hall, 1965, pp. 132-134).

Analysis of 30-Day Averages of Pollutant Discharge Values to Determine 30-Day Maximum Variability Factors

The mill-specific data for each pollutant were divided into periods with 30 days of measurement. These periods were constructed without regard to whether the days fell into a calendar month period or whether measurements on adjacent days were available. For instance, if 30 daily measurements were

TABLE III-68

DISTRIBUTION OF DAILY VALUES ABOUT
THE ESTIMATE OF THE 99th PERCENTILE

	Percentage of Points ≤99th Percentile	Percentage of Points >99th Percentile	Totals
TSS	99.2% (29,755)*	0.8% (247)*	100.0% (30,002)*
BOD5	99.2% (28,860)*	0.8% (244)*	100.0% (29,104)*

* Actual number of daily data points given in parentheses.

TABLE III-69
VARIABILITY FACTORS FOR DETERMINING MAXIMUM DAY LIMITATIONS(a)

BIOLOGICAL TREATMENT: SUBSETS (1), (2), AND (3)
PRIMARY CLARIFICATION: SUBSETS (4)
CHEMICALLY ASSISTED CLARIFICATON: SUBSET (5)

Mill Number	BOD5		TSS		Mills Used to Calculate Averages by Subsets (1)(2)(3)(4)(5)
	Number of Data Points	Maximum Day Average	Number of Data Points	Maximum Day Average	
MILLS WITH BIOLOGICAL TREATMENT					
032002	1,000*	2.00	1,003*	2.41	(1)(2)(3)
032003	875*	2.15	837*	2.12	(1)
030005	859	3.11	881	2.04	(1)
030032	916*	2.17	55*	(b)	(1)(2)(3)
030046	721*	2.83	730*	4.16	(1)(2)(3)
030027	986*	3.42	992*	4.76	(1)(2)(3)
030020	1,002*	2.64	998*	2.26	(1)(2)(3)
010002	568*	1.80	630*	1.52	(1)(2)(3)
010019	429*	2.99	424*	2.25	(1)(2)(3)
010005	1,004	3.32	1,004	2.46	(1)
020017	914	2.75	914	2.17	(1)(2)(3)
020009	332	2.52	341	2.46	(1).
060004	957*	1.94	956*	2.87	(1)(2)(3)
015001	642	3.39	652	2.76	(1)(2)(3)
015001	97*	2.72	104*	2.47	(1)(2)(3)
040012	522*	2.56	610*	1.90	(1)
040009	759*	2.05	759*	2.17	(1)(2)(3)
040019	127	3.70	303	2.91	(1)(2)(3)
040010	369	2.27	369	1.97	(1)(2)(3)
040010	541*	1.57	541*	2.32	(1)(2)(3)
070001	926	3.88	971	5.98	(1)(2)(3)
054015	993*	3.74	954*	4.78	(1)
052008	952*	6.73	961*	5.93	(1)(2)(3)
030044	693*	1.86	701*	2.34	(1)(2)(3)
140007	778*	4.79	779*	7.40	(1)(2)(3)
140019	982*	3.61	983*	3.76	(1)(2)(3)
140015	153	2.54	153	2.36	(1)(2)(3)
140015	710*	3.28	710*	3.65	(1)(2)(3)
140021	119	5.34	119	2.61	(1)(2)(3)
140021	409*	2.94	409*	2.99	(1)(2)(3)
140025	295*	2.29	740*	1.73	(1)(2)(3)
140030	999*	3.25	999*	4.29	(1)(2)(3)
100005	141*	4.42	357	3.68	(1)(2)(3)
090004	999	2.56	999	2.94	(1)(2)(3)
110077	373	3.29	279	2.70	(1)(2)(3)
110031	421*	4.49	418*	4.42	(1)(2)(3)
080041	968	2.56	974	4.27	(1)(2)(3)
080046	396*	1.94	396*	1.98	(1)(2)(3)

TABLE III-69(continued)
VARIABILITY FACTORS FOR DETERMINING
MAXIMUM DAY LIMITATIONS(a)

BIOLOGICAL TREATMENT: SUBSETS (1), (2), AND (3)
PRIMARY CLARIFICATION: SUBSETS (4)
CHEMICALLY ASSISTED CLARIFICATON: SUBSET (5)

	BOD5		TSS		
Mill Number	Number of Data Points	Maximum Day Average	Number of Data Points	Maximum Day Average	Mills Used to Calculate Averages by Subsets (1)(2)(3)(4)(5)
MILLS WITH PRIMARY CLARIFICATION					
090008	964*	1.92	976*	5.49	(4)
090019	797	1.80	797	2.59	(4)
090019	181*	1.76	181*	2.09	(4)
090022	52	(b)	368	3.36	(4)
090022	85*	(b)	595*	2.68	(4)
080022	898*	3.47	898*	2.85	(4)
105020	354	4.36	354	4.01	(4)
105020	440*	3.75	440*	2.93	(4)
MILLS WITH CHEMICALLY ASSISTED CLARIFICATION					
060001	381*	2.83	379*	2.39	(5)
080027(c)	456*	2.56	454*	2.92	(5)

*Denotes refrigerated data

(a)Subset Descriptions:

(1)All mills with biological treatment.
(2)Mills with biological treatment; final effluent levels at or better than BPT.
(3)Mills with biological treatment; final effluent levels at or better than BPT. Biological treatment is the technology basis of BPT effluent limits.
(4)Mills with primary treatment; final effluent levels at or better than BPT limits. Primary clarification is the technology basis of BPT effluent limits.
(5)All mills with chemically assisted clarification.

(b)Insufficient data for analysis.

(c)Mill has rotating biological surface treatment system which is not representative of BPT technology. Data have not been included in averages.

available from January 1 to February 15, these 30 measurements were used to construct one 30-day average to be included in the analysis. If the next 30 measurements were available during February 16 to March 25, these would constitute the next 30-day average and so on. The mill-specific 30-day averages so constructed were found to fit the normal distribution adequately on the basis of goodness-of-fit tests. These tests were performed using the mean of the 30-day means and the standard deviation of the 30-day means to estimate the mean and standard deviation of the hypothesized distribution. The results of the goodness-of-fit tests are summarized in Table III-70 and are consistent with the Central Limit Theorem. Using X_{30} and S_{30} to denote the mean and standard deviation of the 30 day averages, respectively, for a particular mill, the 99th percentiles were estimated as $X_{30} + 2.22\ S_{30}$.

EPA also examined the effects of daily dependence, monthly dependence, and seasonality using a time series model. A simpler version of this time series model was used to determine maximum 30-day average variability in establishing effluent limitations guidelines and standards for the Timber Products Processing Point Source Category (See reference 16, _Final Development Document for Effluent Limitations Guidelines and Standards for the Timber Products Point Source Category_, U.S. Environmental Protection Agency, Washington, D.C., January 1981). The results show that, although seasonality has the most important effect on maximum 30-day average variability factors, the method used in this study for estimating 99th percentiles accounts for seasonality and provides representative maximum 30-day average variability factors.

The conclusions above are supported by additional analyses conducted by the Agency. On a mill-specific basis, each 30-day average was compared to the corresponding mill-specific 99th percentile estimate. Table III-71 displays the aggregate results of comparing each 30-day average to its corresponding 99th percentile estimate of the distribution of 30-day averages of pollutant values for BOD_5 and TSS. The percentage of 30-day averages exceeding the 99th percentile estimate is substantially the same as the expected one percent. Table III-72 displays mill-specific maximum 30-day average variability factors for BOD_5 and TSS, obtained by dividing the 99th percentile estimates by the long-term average pollutant values.

Establishment of Applicable Variability Factors

Biological Treatment - Tables III-69 and III-72 present the individual mills' 30-day average and daily maximum variability factors for BOD_5 and TSS for those mills with biological treatment systems. For many subcategories, biological treatment is the technology basis for achieving the effluent reduction required under BCT guidelines. Variability factors compiled for each mill were averaged across mills, and one 30-day average and one daily variability factor were determined for BOD_5 and TSS. These two variability factors were used to establish 30-day

TABLE III-70

RESULTS OF GOODNESS-OF-FIT TESTS FOR SUCCESSIVE 30-DAY AVERAGES(a)

		BOD5				TSS			
Subcategory Name	Mill Number	Number of Means	Test Statistic	Critical Value at $\alpha = 0.01$	Decision(b)	Number of Means	Test Statistic	Critical Value at $\alpha = 0.01$	Decision(b)
Dissolving Kraft	032002*	33	0.0530	0.1795	NS	33	0.1085	0.1795	NS
	032003*	29	0.0899	0.1896	NS	27	0.0719	0.1948	NS
Market Bleached Kraft	030005	28	0.2274	0.1922	Sig $\alpha = 0.01$	29	0.1289	0.1896	NS
BCT Bleached Kraft	030032*	30	0.1045	0.1870	NS	1	-	-	-(c)
Alkaline-Fine(d)	030046*	24	0.2295	0.2062	Sig $\alpha = 0.01$	24	0.2715	0.2062	Sig $\alpha = 0.01$
	030027*	32	0.0949	0.1823	NS	33	0.1840	0.1795	Sig $\alpha = 0.01$
	030020*	33	0.1647	0.1795	NS	33	0.0718	0.1795	NS
Unbleached Kraft o Linerboard	010002*	18	0.1593	0.2390	NS	21	0.1376	0.2248	NS
	010019*	14	0.1801	0.2610	NS	14	0.1989	0.2610	NS
o Bag	010005	33	0.1679	0.1795	NS	33	0.1815	0.1795	Sig $\alpha = 0.01$
Semi-Chemical	020017	30	0.1272	0.1870	NS	30	0.1234	0.1870	NS
	020009	11	0.1782	0.2840	NS	11	0.2581	0.2840	NS
	060004*	31	0.0904	0.1852	NS	31	0.0984	0.1852	NS
Unbleached Kraft and Semi-Chemical	015001	21	0.2332	0.2248	Sig $\alpha = 0.01$	21	0.1180	0.2248	NS
	015001*	3	-	-	-(c)	3	-	-	-(c)
Papergrade Sulfite(e)	040012*	17	0.2398	0.2450	NS	20	0.1270	0.2310	NS
	040009*	25	0.1207	0.2000	NS	25	0.1820	0.2000	NS
	040019	4	-	-	-(c)	10	0.2316	0.2940	NS
	040010	12	0.1672	0.2750	NS	12	0.2321	0.2750	NS
	040010*	18	0.0684	0.2390	NS	18	0.2044	0.2390	NS
Groundwood-Fine Papers	052008*	30	0.2569	0.1852	Sig $\alpha = 0.01$	32	0.1480	0.1823	NS
Groundwood-Thermo-Mechanical	070001	30	0.1407	0.1870	NS	32	0.1622	0.1823	NS
Groundwood-CMN Papers	054015*	33	0.0777	0.1795	NS	31	0.1502	0.1852	NS
Integrated Miscellaneous	030044*	23	0.0808	0.2124	NS	23	0.1819	0.2124	NS
	060001*	12	0.2234	0.2750	NS	12	0.2248	0.2750	NS
Deink o Fine Papers	140007*	25	0.2416	0.2000	Sig $\alpha = 0.01$	25	0.2020	0.2000	Sig $\alpha = 0.01$
	140019*	32	0.1483	0.1823	NS	32	0.1183	0.1823	NS

TABLE III-70 (continued)

RESULTS OF GOODNESS-OF-FIT TESTS FOR SUCCESSIVE 30-DAY AVERAGES(a)

		BOD5				TSS			
Subcategory Name	Mill Number	Number of Means	Test Statistic	Critical Value at $\alpha = 0.01$	Decision(b)	Number of Means	Test Statistic	Critical Value at $\alpha = 0.01$	Decision(b)
o Tissue Papers	140015	5	0.1679	0.4050	NS	5	0.1427	0.4050	NS
	140015*	23	0.2082	0.2124	NS	23	0.1410	0.2124	NS
	140021	3	-	-	-(c)	3	-	-	-(c)
	140021*	13	0.1681	0.2680	NS	13	0.1518	0.2680	NS
	140025*	9	0.1469	0.3110	NS	24	0.0981	0.2062	NS
	140030*	33	0.1826	0.1795	Sig $\alpha = 0.01$	33	0.1526	0.1795	NS
Tissue From Wastepaper	100005**	4	-	-	-(c)	11	0.1966	0.2840	NS
	090004	33	0.0896	0.1795	NS	33	0.1499	0.1795	NS
Paperboard From Wastepaper	110077	12	0.2026	0.2750	NS	9	0.1320	0.3110	NS
	110031*	14	0.2303	0.2610	NS	13	0.2212	0.2680	NS
Nonintegrated-Fine Papers	080041	32	0.1606	0.1823	NS	32	0.1173	0.1823	NS
	080046*	13	0.1270	0.2680	NS	13	0.2576	0.2680	NS
	080027*	14	0.2383	0.2610	NS(f)	15	0.2009	0.2570	NS
Nonintegrated-Tissue Papers	090008*	32	0.1333	0.1823	NS	32	0.2080	0.1823	Sig $\alpha = 0.01$
	090019	26	0.1243	0.1974	NS	26	0.0781	0.1974	NS
	090019*	6	0.1816	0.3640	NS	6	0.2375	0.3640	NS
	090022	1	-	-	-(c)	12	0.1178	0.2750	NS
	090022*	2	-	-	-(c)	19	0.0974	0.2350	NS
Nonintegrated-Lightweight Papers									
	080022*	29	0.1050	0.1896	NS	29	0.1371	0.1896	NS
	105020	11	0.1801	0.2840	NS	11	0.2010	0.2840	NS
	105020*	14	0.1277	0.2610	NS	14	0.1749	0.2610	NS

*Refrigerated BOD5 and TSS data.
**Refrigerated BOD5 data only.

(a)Lilliefors, H., "On the Kolmogorov-Smirnov Tests for Normality with Mean and Variance Unknown," J. Am. Statistical Assoc., Vol. 62, 1967. (208)
(b)Reject H_o at the level α if test statistic exceeds critical value for the particular sample size N. NS denotes hypothesis test results not significant (i.e., do not reject H_o: data comes from a normal distribution).
(c)Insufficient data for analysis.
(d)Includes Fine Bleached Kraft and Soda subcategories.
(e)Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories.
(f)Although the set of successive 30-day averages was not found to be normally distributed, the set of successive 31-day averages was found to be normally distributed using the Lilliefors Test.

TABLE III-71

DISTRIBUTION OF 30-DAY AVERAGES ABOUT THE ESTIMATE OF THE 99th PERCENTILE

	Percentage of Points ≤99th Percentile	Percentage of Points >99th Percentile	Totals
TSS	98.2% (961)*	1.8% (18)*	100.0% (979)
BOD5	98.1% (930)*	1.9% (18)*	100.0% (948)

* Actual number of successive 30-day averages given in parentheses.

TABLE III-72
VARIABILITY FACTORS FOR DETERMINING
MAXIMUM 30-DAY LIMITATIONS(a)

BIOLOGICAL TREATMENT: SUBSETS (1), (2), AND (3)
PRIMARY CLARIFICATION: SUBSETS (4)
CHEMICALLY ASSISTED CLARIFICATON: SUBSET (5)

Mill Number	BOD5 Number of Data Points	BOD5 Maximum 30-Day Average	TSS Number of Data Points	TSS Maximum 30-Day Average	Mills Used to Calculate Averages by Subsets (1)(2)(3)(4)(5)
MILLS WITH BIOLOGICAL TREATMENT					
032002	1,000*	1.49	1,003*	1.50	(1)(2)(3)
032003	875*	1.56	837*	1.39	(1)
030005	859	2.02	881	1.39	(1)
030032	916*	1.86	55*	(b)	(1)(2)(3)
030046	721*	2.00	730*	2.52	(1)(2)(3)
030027	986*	1.47	992*	2.14	(1)(2)(3)
030020	1,002*	1.73	998*	1.55	(1)(2)(3)
010002	568*	1.56	630*	1.38	(1)(2)(3)
010019	429*	1.68	424*	1.35	(1)(2)(3)
010005	1,004	2.00	1,004	2.00	(1)
020017	914	2.02	914	1.81	(1)(2)(3)
020009	332	1.65	341	1.52	(1)
060004	957*	1.46	956*	1.79	(1)(2)(3)
015001	642	2.55	652	2.11	(1)(2)(3)
015001	97*	(b)	104*	(b)	(1)(2)(3)
040012	522*	1.76	610*	1.56	(1)
040009	759*	1.51	759*	1.66	(1)(2)(3)
040019	127	(b)	303	1.94	(1)(2)(3)
040010	369	1.91	369	1.49	(1)(2)(3)
040010	541*	1.30	541*	1.49	(1)(2)(3)
070001	926	1.89	971	2.25	(1)(2)(3)
054015	993*	2.12	954*	2.22	(1)
052008	952*	2.82	961*	2.43	(1)(2)(3)
030044	693*	1.34	701*	1.46	(1)(2)(3)
140007	778*	2.42	779*	2.52	(1)(2)(3)
140019	982*	2.09	983*	1.65	(1)(2)(3)
140015	153	1.77	153	1.40	(1)(2)(3)
140015	710*	1.80	710*	1.94	(1)(2)(3)
140021	119	(b)	119	(b)	(1)(2)(3)
140021	409*	1.71	409*	1.63	(1)(2)(3)
140025	295*	1.58	740*	1.28	(1)(2)(3)
140030	999*	2.08	999*	2.24	(1)(2)(3)
100005	141*	(b)	356	2.35	(1)(2)(3)
090004	999	2.11	999	2.02	(1)(2)(3)
110077	373	2.08	279	1.82	(1)(2)(3)
110031	421*	2.37	418*	2.44	(1)(2)(3)
080041	968	1.85	974	2.08	(1)(2)(3)
080046	396*	1.39	396*	1.53	(1)(2)(3)

TABLE III-72 (continued)
VARIABILITY FACTORS FOR DETERMINING
MAXIMUM 30-DAY LIMITATIONS(a)

BIOLOGICAL TREATMENT: SUBSETS (1), (2), AND (3)
PRIMARY CLARIFICATION: SUBSETS (4)
CHEMICALLY ASSISTED CLARIFICATON: SUBSET (5)

	BOD5		TSS		Mills Used to Calculate Averages by Subsets
Mill Number	Number of Data Points	Maximum 30-Day Average	Number of Data Points	Maximum 30-Day Average	(1)(2)(3)(4)(5)
MILLS WITH PRIMARY CLARIFICATION					
090008	964*	1.32	976*	1.92	(4)
090019	797	1.45	797	1.44	(4)
090019	181*	1.53	181*	1.29	(4)
090022	52	(b)	368	1.30	(4)
090022	85*	(b)	595*	1.33	(4)
080022	898*	1.64	898*	1.46	(4)
105020	354	1.62	354	1.86	(4)
105020	440*	1.48	440*	1.55	(4)
MILLS WITH CHEMICALLY ASSISTED CLARIFICATION					
060001	381*	2.05	379*	1.41	(5)
080027	456*	2.10	454*	2.15	(5)

*Denotes refrigerated data

(a)Subset Descriptions:

(1)All mills with biological treatment.
(2)Mills with biological treatment; final effluent levels at or better than BPT.
(3)Mills with biological treatment; final effluent levels at or better than BPT. Biological treatment is the technology basis of BPT effluent limits.
(4)Mills with primary treatment; final effluent levels at or better than BPT limits. Primary clarification is the technology basis of BPT effluent limits.
(5)All mills with chemically assisted clarification.

(b)Insufficient data for analysis.

(c)Mill has rotating biological surface treatment system which is not representative of BPT Techology. Data have not been included in averages.

average and daily maximum effluent limitations controlling the discharge of conventional pollutants from the subcategories where biological treatment forms the technology basis.

Minimum, maximum, and average variability factors were determined for each of three subsets of mills. These subsets were developed from a group of mills with biological treatment systems and are as follows:

Subset Number	Subset Description
(1)	Mills with biological treatment systems.
(2)	Mills with biological treatment systems and effluent levels at or better than BPT limitations. Biological treatment is not necessarily the treatment technology on which BPT is based for some of these mills (i.e., primary treatment forms the basis of BPT effluent limitations applicable to discharges from some of these mills).
(3)	Mills with biological treatment systems and effluent levels at or better than BPT. Biological treatment is the technology on which BPT effluent limitations are based for these mills.

Maximum daily and maximum 30-day average variability factors for these subsets are shown in Table III-73. Maximum daily and maximum 30-day average variability factors for these three subsets are shown in Table III-73. The 30-day average variability factors determined for each of the three subsets of mills are nearly equal to the variability factors used in the development of the BPT Phase II effluent limitations guidelines. Therefore, EPA has determined that the BCT 30-day average effluent variability factors for BOD5 and TSS are identical to the 30-day average variability factors developed for BPT Phase II effluent limitations for subcategories for which biological treatment is the basis of BPT. Hence, the 30-day average variability factors for BOD5 and TSS, to be applied to those technology options where biological treatment is the technology basis, are as follows:

30-Day Average Variability Factors

BOD5 = 1.78
TSS = 1.82

TABLE III-73
AVERAGE MAXIMUM 30-DAY AND MAXIMUM DAY VARIABILITY FACTORS FOR SUBSETS (1), (2), (3), (4), AND (5)

Subset	BOD5		TSS	
	Maximum 30-Day Average	Maximum Day Average	Maximum 30-Day Average	Maximum Day Average
(1) ALL MILLS WITH BIOLOGICAL TREATMENT				
(A) With Refrigerated Sample Collection				
Minimum	1.30	1.57	1.28	1.52
Maximum	2.82	6.73	2.52	7.40
Average	1.79	2.97	1.80	3.24
(B) With Unrefrigerated Sample Collection				
Minimum	1.65	2.27	1.39	1.97
Maximum	2.55	5.34	2.35	5.98
Average	1.99	3.17	1.86	2.95
(2) MILLS WITH BIOLOGICAL TREATMENT; FINAL EFFLUENT LEVELS AT OR BETTER THAN BPT				
(A) With Refrigerated Sample Collection				
Minimum	1.30	1.57	1.28	1.52
Maximum	2.82	6.73	2.52	7.40
Average	1.78	2.99	1.82	3.28
(B) With Unrefrigerated Sample Collection				
Minimum	1.77	2.27	1.40	1.97
Maximum	2.55	5.34	2.35	5.98
Average	2.02	3.23	1.93	3.12
(3) MILLS WITH BIOLOGICAL TREATMENT; FINAL EFFLUENT LEVELS AT OR BETTER THAN BPT. BIOLOGICAL TREATMENT IS THE TECHNOLOGY BASIS OF BPT EFFLUENT LIMITS				
(A) With Refrigerated Sample Collection				
Minimum	1.30	1.57	1.28	1.52
Maximum	2.82	6.73	2.52	7.40
Average	1.78	2.99	1.82	3.28
(B) With Unrefrigerated Sample Collection				
Minimum	1.77	2.27	1.40	1.97
Maximum	2.55	5.34	2.35	5.98
Average	2.02	3.23	1.93	3.12

TABLE III-73 (continued)
AVERAGE MAXIMUM 30-DAY AND MAXIMUM DAY VARIABILITY FACTORS FOR SUBSETS (1), (2), (3), (4), AND (5)

Subset	BOD5		TSS	
	Maximum 30-Day Average	Maximum Day Average	Maximum 30-Day Average	Maximum Day Average
(4) MILLS WITH PRIMARY CLARIFICATION; FINAL EFFLUENT LEVELS AT OR BETTER THAN BPT LIMITS. PRIMARY CLARIFICATION IS THE TECHNOLOGY BASIS OF BPT EFFLUENT LIMITS				
(A) With Refrigerated Sample Collection				
Minimum	1.32	1.76	1.29	2.09
Maximum	1.64	3.75	1.92	5.49
Average	1.49	2.73	1.51	3.21
(B) With Unrefrigerated Sample Collection				
Minimum	1.45	1.80	1.30	2.59
Maximum	1.62	4.3	1.86	4.01
Average	1.54	3.08	1.53	3.32
(5) MILLS WITH CHEMICALLY ASSISTED CLARIFICATION				
(A) With Refrigerated Sample Collection				
Minimum	2.05	2.56	1.41	2.39
Maximum	2.10	2.83	2.14	2.92
Average	2.08	2.70	1.78	2.66
(B) With Unrefrigerated Sample Collection No Data Available.				

The average daily maximum variability factors for BOD_5 and TSS for each of the three subsets of mills with biological treatment systems are given in Table III-73. These variability factors are lower than the variability factors used to develop the BPT Phase II daily maximum effluent limitations. Because these variability factors are based on recent operating data, EPA has decided to apply them to determine effluent limitations for the technology options where biological treatment is the technology basis. As the daily maximum variability factors for the three subsets are approximately equal, the daily maximum variability factors for the options where biological treatment is the technology basis are as follows:

Daily Maximum Variability Factors

BOD_5 = 3.0
TSS = 3.0

Primary Treatment - Wastewater data from mills where primary clarification is employed were also collected as part of the supplemental data request program. Daily maximum and maximum 30-day variability factors for subcategories with such treatment were determined using the methods which were applied to data from mills with biological treatment systems and are described previously.

Minimum, maximum, and average variability factors were determined for the following subset of mills. This subset was developed from the group of mills with primary clarification and is as follows:

Subset Number	Subset Description
(4)	Mills with effluent levels at or better than BPT with primary clarification as the technology basis of BPT effluent limits.

Maximum daily and maximum 30-day average variability factors for the subset of mills with primary clarification are shown in Table III-73. Both the maximum daily and the 30-day average variability factors determined for the subset are nearly equal to the variability factors used in the development of the BPT Phase II effluent limitations guidelines. Therefore, EPA has determined that the maximum daily and the 30-day average variability factors for BOD_5 and TSS are identical to the maximum daily and the 30-day average variability factors developed for BPT Phase II effluent limitations for subcategories for which primary treatment is the basis of BPT. Hence, for BOD_5 and TSS, the maximum daily and the 30-day average variability factors to be applied for the technology options where primary treatment is the technology basis are as follows:

30-Day Average Variability Factor

$BOD_5 = 1.79$
$TSS = 1.76$

Daily Maximum Variability Factors

$BOD_5 = 3.25$
$TSS = 3.60$

Chemically Assisted Clarification - Chemically assisted clarification is the basis for some BCT technology options. At present, mill 060001 and 080027 are the only mills for which long-term wastewater data are available. However, mill 080027 uses a rotating biological surface treatment system, which is not representative of BPT technology and data from this mill are not included in the averages. Therefore, the variability factors determined for mill 060001 have been applied as the factors for calculating effluent limitations for the technology option based on chemically assisted clarification. The BOD_5 and TSS maximum 30-day average and daily maximum variability factors for mill 060001 are shown in Table III-73.

Table III-74 summarizes the variability factors to be used to calculate BCT effluent limitations guidelines for the conventional pollutants BOD_5 and TSS for the various technology options.

TABLE III-74

SUMMARY OF VARIABILITY FACTORS FOR BCT OPTIONS 1, 2, 3, and 4

BCT Option	BOD5		TSS	
	Maximum 30-Day Average	Maximum Day	Maximum 30-Day Average	Maximum Day
1 & 4	1.78	3.00	1.82	3.00
2 & 3	2.05	2.83	1.41	2.39

The above variability factors apply for the following subcategories:

Dissolving Kraft
Market Bleached Kraft
BCT Bleached Kraft
Alkaline-Fine
 (including Fine Bleached Kraft and Soda)
Unbleached Kraft
Semi-Chemical
Unbleached Kraft and Semi-Chemical
Dissolving Sulfite Pulp
Papergrade Sulfite (Blow Pit and Drum Wash)

Groundwood-Thermo-Mechanical
Groundwood-CMN Papers
Groundwood-Fine Papers

Deink
Tissue From Wastepaper
Paperboard From Wastepaper
Wastepaper-Molded Products
Builders' Paper and Roofing Felt
Nonintegrated-Fine Papers

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1 & 4	1.79	3.25	1.76	3.60
2 & 3	1.78	3.00	1.82	3.00

The above variability factors apply for the following subcategories:

Nonintegrated-Tissue Papers
Nonintegrated-Lightweight Papers
Nonintegrated-Filter and Nonwoven Papers
Nonintegrated-Paperboard

SECTION IV

COST, ENERGY, AND NON-WATER QUALITY ASPECTS

INTRODUCTION

Previous sections described the BCT control options that were considered as the basis of regulations. This section summarizes the cost, energy, and other non-water quality impacts of the various control and treatment options. Other non-water quality aspects addressed in this document are implementation requirements, air pollution, noise pollution, and solid waste generation.

METHODOLOGY FOR DEVELOPMENT OF COSTS

General

The actual cost of implementing control and treatment options can vary at each individual facility depending on the design and operation of the production facilities and local conditions. EPA developed control and treatment costs, based on engineering estimates, that are representative of each subcategory of the pulp, paper, and paperboard industry. Where possible, the cost estimates were compared to costs reported by industry representatives and were revised where appropriate. However, accounting procedures used at different mills vary which complicates the use of industry cost data.

To assess the overall economic impact of the various treatment and control options on the pulp, paper, and paperboard industry, EPA developed model mill cost estimates for 31 distinct subcategories and subcategory sectors. The model mill approach, mill and site specific cost factors, and cost estimating criteria are discussed below.

Model Mill Approach

To estimate the costs associated with the BCT control options, EPA developed up to three different model mills for each of the subcategories of the pulp, paper, and paperboard industry. EPA based model mill sizes on the actual variation of size within each subcategory; model mill sizes are presented by subcategory in Table IV-1.

Mill and Site Specific Cost Factors

Specific mills in a subcategory may differ from the subcategory model mills. These differences result in mill-to-mill variations in the costs associated with achieving the various effluent quality levels specified for each subcategory. Among the factors affecting costs are location, climate, mill age, savings resulting from implementation of various controls, retrofit

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TABLE IV-1

MODEL MILL SIZES
SUBCATEGORY

Subcategory	Direct Dischargers (kkg/d)	Direct Dischargers (t/d)
Integrated Segment		
Dissolving Kraft	907	1,000
Market Bleached Kraft	318	350
	544	600
	1,451	1,600
BCT Bleached Kraft	272	300
	726	800
	1,179	1,300
Alkaline-Fine[1]	181	200
	726	800
	1,089	1,200
Unbleached Kraft		
o Linerboard	408	450
	907	1,000
	1,361	1,500
o Bag	408	450
	907	1,000
	1,361	1,500
Semi-Chemical	181	200
	386	425
	544	600
Unbleached Kraft and Semi-Chemical	635	700
	1,361	1,500
	2,359	2,600
Dissolving Sulfite Pulp	408	450
	544	600
Papergrade Sulfite[2]	91	100
	408	450
	907	1,000
Groundwood-Thermo-Mechanical	272	300
Groundwood-CMN Papers	45	50
	544	600
	907	1,000
Groundwood-Fine Papers	68	75
	454	500
	680	750
Secondary Fibers Segment		
Deink		
o Fine Papers	163	180
	363	400
	726	800

TABLE IV-1 (continued)

MODEL MILL SIZES
SUBCATEGORY

	Direct Dischargers	
Subcategory	(kkg/d)	(t/d)
o Tissue Papers	23	25
	45	50
	163	180
o Newsprint	NA	NA
Tissue From Wastepaper	9	10
	36	40
Paperboard From Wastepaper	45	50
	145	160
	635	700
Wastepaper-Molded Products	18	20
	45	50
	136	150
Builders' Paper and Roofing Felt	91	100
	204	225
Nonintegrated Segment		
Nonintegrated-Fine Papers		
o Wood Fiber Furnish	32	35
	195	215
	907	1,000
o Cotton Fiber Furnish	9	10
	45	50
	91	100
Nonintegrated-Tissue Papers	32	35
	163	180
	907	1,000
Nonintegrated-Lightweight Papers	9	10
	54	60
	181	200
Nonintegrated-Filter and Nonwoven	5	5
	18	20
	41	45
Nonintegrated-Paperboard	9	10
	36	40
	68	75

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[1] Includes Fine Bleached Kraft and Soda subcategories.

[2] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories.

requirements, site limitations, raw wastewater quality, and production capacity. In addition, at certain mills, different combinations of production processes are employed.

Location. Differences exist in construction practice, labor rates, and energy costs due to geographic location. EPA based model mill costs on national averages. Regional cost factors are presented in Table IV-2 so that model mill costs may be adjusted to represent specific geographic areas.(18)(19)(20)(21)

Climate. Biological treatment systems constructed in cold climates often require longer detention times than those constructed in warmer climates; this is due to bio-kinetic relationships (see Section VII of reference 1, the December 1980 development document supporting the proposed regulations). Longer detention times require higher capital and operating costs. The costs presented reflect design in areas of moderate climate and represent the median anticipated values.

Climate can also affect the construction details of the various components. Open pit pumps, above ground piping, and exposed process equipment are characteristic of warm climate mills; mills in colder climates cannot use such designs. Model mill cost estimates reflect design based on cold climates, so costs at mills in warm climates may be lower than these estimates.

Production Capacity. Economies of scale are likely to vary depending on the equipment to be installed or constructed. Each control and treatment option was evaluated over a representative range of mill sizes for each subcategory to account for variations and the effect of mill size.

Age. Mill age can affect the cost of implementing various process controls; this was considered in the development of model mill costs by accounting for the relative difficulty of installing and replacing process equipment and effluent sewers.

The chronological age of a mill, however, is not always a good measure of the relative ease with which controls may be implemented. As a result of extensive rebuilding or expansion programs implemented at older mills, conditions often allow for ease of installation of additional production process controls.

Material and Energy Savings. More efficient mill operation and substantial savings of material and energy can result from installation of production process controls. Material and energy savings were considered where appropriate and net costs of operation, maintenance, and energy were calculated.

Other Savings. There are other savings that may result from implementation of production process controls in addition to savings in materials and energy. Such additional savings, which are not accounted for in the cost estimates presented in this document, result from improved recovery systems and manufacture of by-products such as black liquor soap, turpentine, solvents,

TABLE IV-2

MODEL MILL SIZES AND OTHER PARAMETERS USED TO DETERMINE BCT OPTION 1 COSTS

Subcategory	Paper Production (kkg/d)	Pulp Production (kkg/d)	Number of Washer Lines	Number of Bleach Lines	Number of Evaporators	Number of Paper Machines
Integrated Segment						
Dissolving Kraft	907	907	2	--	4	2
Market Bleached Kraft	318	318	1	--	1	1
	544	544	1	--	1	1
	1,451	1,451	2	--	3	3
BCT Bleached Kraft	272	272	1	--	--	1
	726	726	2	--	--	2
	1,179	1,179	3	--	--	4
Alkaline-Fine[1]	181	109	1	1	1	2
	726	545	2	1	2	3
	1,089	907	2	2	3	5
Unbleached Kraft						
o Linerboard	408	408	1	--	--	1
	907	907	2	--	--	2
	1,361	1,361	3	--	--	2
o Bag	408	408	1	--	--	1
	907	907	2	--	--	2
	1,361	1,361	3	--	--	2
Semi-Chemical	181	114	1	--	--	1
	386	273	1	--	--	2
	544	477	2	--	--	3
Unbleached Kraft and Semi-Chemical	635	635[2]	1[5]	1[6]	--	3
	1,361	1,361[3]	1[5]	2[6]	--	5
	2,359	2,359[4]	1[5]	2[6]	--	7
Dissolving Sulfite Pulp	408[7]	408	--	--	--	1
	544[8]	544	--	--	--	1
Papergrade Sulfite[9]	91	36	1	1	--	3
	408	204	1	1	--	4
	907	544	1	1	--	6
Groundwood-Thermo-Mechanical[10]	NA	--	--	--	--	--
Groundwood-CMN Papers	45	45	--	--	--	1
	544	408	--	--	--	2
	907	658	--	--	--	6
Groundwood-Fine Papers	68	54	--	--	--	1
	454	145	--	--	--	3
	680	454	--	--	--	4

TABLE IV-2 (continued)

MODEL MILL SIZES AND OTHER PARAMETERS
USED TO DETERMINE BCT OPTION 1 COSTS

Subcategory	Paper Production (kkg/d)	Pulp Production (kkg/d)	Number of Washer Lines	Number of Bleach Lines	Number of Evaporators	Number of Paper Machines
Secondary Fibers Segment						
Deink						
o Fine Papers	163	109	--	--	--	1
	363	227	--	--	--	2
	726	381	--	--	--	3
o Tissue Papers	23	23	--	--	--	1
	45	45	--	--	--	2
	163	154	--	--	--	4
o Newsprint[10]	NA	--	--	--	--	--
Tissue From Wastepaper	9	--	--	--	--	1
	36	--	--	--	--	3
Paperboard From Wastepaper	45	--	--	--	--	1
	145	--	--	--	--	2
	635	--	--	--	--	4
Wastepaper-Molded Products	18	--	--	--	--	2
	45	--	--	--	--	3
	136	--	--	--	--	7
Builders' Paper and Roofing Felt	91	--	--	--	--	1
	204	--	--	--	--	3
Nonintegrated Segment						
Nonintegrated-Fine Papers						
o Wood Fiber Furnish	32	--	--	--	--	1
	195	--	--	--	--	2
	907	--	--	--	--	6
o Cotton Fiber Furnish	9	--	--	--	--	1
	45	--	--	--	--	2
	91	--	--	--	--	3
Nonintegrated-Tissue Papers	32	--	--	--	--	1
	163	--	--	--	--	2
	907	--	--	--	--	5
Nonintegrated-Lightweight Papers	9	--	--	--	--	1
	54	--	--	--	--	2
	181	--	--	--	--	6
Nonintegrated-Filter and Nonwoven	5	--	--	--	--	1
	18	--	--	--	--	2
	41	--	--	--	--	3

TABLE IV-2 (continued)

MODEL MILL SIZES AND OTHER PARAMETERS USED TO DETERMINE BCT OPTION 1 COSTS

Subcategory	Paper Production (kkg/d)	Pulp Production (kkg/d)	Number of Washer Lines	Number of Bleach Lines	Number of Evaporators	Number of Paper Machines
Nonintegrated-Paperboard	9	--	--	--	--	1
	36	--	--	--	--	1
	68	--	--	--	--	2

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[1] Includes Fine Bleached Kraft and Soda subcategories.
[2] Includes 95 kkg/d of semi-chemical pulp and 454 kkg/d of unbleached kraft pulp.
[3] Includes 227 kkg/d of semi-chemical pulp and 1134 kkg/d of unbleached kraft pulp.
[4] Includes 236 kkg/d of semi-chemical pulp and 2086 kkg/d of unbleached kraft pulp.
[5] Number of semi-chemical pulp washer lines.
[6] Number of unbleached kraft pulp washer lines.
[7] Does not employ MgO as a base.
[8] Employs MgO as a base.
[9] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories.
[10] BCT has been set equal to BPT for this subcategory or product sector.

glues, and human and animal nutrients. The recycle of effluent streams may also allow for heat recovery that can represent savings at some mills, particularly in colder climates. Such savings may not be possible at all mills in a subcategory, but may be realized at some mills depending on such factors as location and production processes employed.

Retrofit Requirements. EPA based BCT model mill costs on the assumptions that 1) production and effluent treatment controls that form the basis for BPT effluent limitations have been installed and 2) all facilities are currently attaining BPT effluent limitations. Mills that are not currently attaining existing BPT effluent limitations may incur higher costs for additional treatment to attain predicted levels of pollutant discharges. These costs are not included in the estimates presented in this document as they have been incorporated in previous rulemaking efforts.

Site Limitations. The implementation of additional production process controls or end-of-pipe treatment technologies can require additional land. Spatial relationships and the physical characteristics of available land can affect construction costs. The impacts of mill-by-mill variations are lessened because the options under consideration are not land intensive. Also, where treatment facilities such as clarifiers are added, the cost of pumping to these facilities is included. Costs are considerably overstated for those facilities where gravity flow is possible.

Analysis of information obtained during the data request program indicates that for two-thirds of the operating facilities, land availability is not a problem. For that reason and because of the extensive variability of land acquisition costs, the cost of land acquisition was not included in cost estimates.

Raw Wastewater Characteristics. Flow, BOD5, and TSS loads at individual mills may vary from those of the model mill. These variations can affect the cost of effluent treatment. However, the model mill approach to cost development yields pre-engineering estimates not requiring specific engineering studies at each mill in the industry. It is likely that the approach to achieving effluent limitations chosen by management at individual mills will vary from that considered in establishing the specific limitations. EPA anticipates that mill management will choose the technology that is most cost-effective for each facility.

Combinations of Production Processes. Production processes and the products manufactured frequently vary among mills in the same subcategory. Model mill costs (for BCT Option 1) reflect these differences when it was possible to generalize the differences for a particular subcategory. For example, in many integrated subcategories, mills purchase varying quantities of pulp; as a result, the relative sizes of their pulp and paper mills differ. (See the development of subcategory raw waste loads in Section III.) The costs for a model mill in subcategories where process differences were accounted for reflect the use of processes normal for a mill of the particular model mill size.

Cost Estimating Criteria for Control and Treatment Technologies

EPA developed capital, operation and maintenance, and energy cost estimates based on the criteria presented in Table IV-3.(19-23) The pre-engineering estimates developed for this study are expected to have a variability consistent with this type of estimate and are approximately plus or minus 30 percent.

Capital Cost Criteria. All costs presented in this section, except as noted, are in terms of first quarter 1978 dollars. Since construction costs escalate, these estimates may be adjusted through use of appropriate cost indices. The most accepted and widely-used cost index in the engineering field is the Engineering News Record (ENR) construction cost index. The ENR index value of 2,683 used in this report was taken from the "U.S. - 20 Cities Average" for the first quarter 1978.(22)

Equipment costs were based on supplier quotes, published literature, engineering experience, and data request program responses. Capital costs include allowances for lost production during construction or for additional power facilities as warranted. Additional costs such as engineering and contingencies were based on a percentage of capital and vary from 15 to 25 percent depending on the technology.

A total labor rate of $23.00 per hour was assumed for installation of production process controls. This wage rate is based upon a $19.00 national average wage rate including fringe benefits plus a net supervision rate of $4.00 per hour.(26)

Annual Fixed Charges. The annual fixed charges are the annual costs that are directly related to the construction of pollution abatement facilities. These charges commonly include such items as depreciation of the control equipment and interest on the capital borrowed for construction. In addition, such costs as maintenance materials, spare parts, insurance, and taxes are expressed as a percentage of initial capital expenditures.

The useful life of each structure and mechanical unit varies. Mechanical equipment operating in demanding service conditions may have a useful life of 5 to 10 years whereas a building may have a useful life of 40 to 50 years or more. Depreciation costs are the accounting charges for the eventual replacement of a given asset (equipment or structure) at the end of its useful life. A NCASI report shows an average depreciation rate in the industry of 16.5 years.(27)

Interest is the annual charge for financing the capital expenditures for construction of a facility. Such financing may be through corporate bonds, conventional lending markets, or tax-exempt municipal revenue bonds. Municipal revenue bonds have lower interest rates than corporate bonds. A NCASI report states that 44 percent of the pollution abatement expenditures in 1976

TABLE IV-3

REGIONAL COST ADJUSTMENT FACTORS

Region/State	Capital (210)	Operation and Maintenance (211)(212)	Energy (213)
Northeast	1.03	0.97	1.38
North Central	1.02	1.15	1.18
South	0.90	0.81	1.17
Plains/Mountain	0.96	0.99	1.02
West	1.09	1.12	0.79
Alaska	1.38	1.78	1.16

were financed through tax-exempt municipal bonds.(27)

To calculate total annual costs, EPA used an average fixed charge of 22 percent of the capital expenditures. This figure includes all of the above items. EPA realized that these charges may vary and are dependent upon several factors, such as the complexities of the system installed, financing availability, insurance coverage, property tax credits, spare parts inventory, and maintenance materials.

Energy Costs. An average national electric power cost for large industrial users (200,000 kwh monthly; 1,000 kw demand) was estimated at $0.0366/kwh. This figure was derived from average cost information by state and on electric rates from approximately 200 public and private utilities.(21) Information concerning actual revenues from approximately 200 public and private utilities indicated a cost of $0.0281/kwh.(21) Based on that data, energy costs were estimated at $0.0325/kwh.

Fuel for steam generation was estimated at $12 per barrel. (23)

Operating and Maintenance Labor. The average nonsupervisory labor rate in the pulp and paper industry was reported to be $7.14 per hour in February 1978.(19) Average total benefits for the pulp, paper, lumber, and furniture industry for the year 1977 were reported as 34 percent of wages.(20) Although no industry-wide data concerning supervisory costs were available, the proposed control and treatment technologies under consideration are anticipated to require only minimal additional supervisory labor.

A supervisory and benefits cost of 45 percent of the labor rate was assumed. This results in a total labor rate of $10.35/hr.

Chemicals. Chemical costs were based on quotes from chemical suppliers and chemical marketing reports. The chemicals used in the technologies under evaluation include alum, polymer, phosphoric acid, sulfuric acid, anhydrous ammonia, and sodium hydroxide.

Costs for Implementation of BCT Control and Treatment Options

Four control and treatment options have been considered for the control of conventional pollutants from direct discharging mills in the pulp, paper and paperboard industry. Cost estimates have been prepared for each control and treatment option for all model mills in each subcategory. Table IV-4 presents gross operation and maintenance and energy costs and savings for BCT Option 1 production process controls for medium sized direct dischargers. Table IV-5 shows EPA's cost estimating criteria. Table IV-6 presents capital, operating and maintenance, energy, and total annual costs of implementation for model mills for BCT Options 1, 2, and 3. Table IV-7 presents these costs for BCT Option 4. The total capital and annual costs for compliance with BPT and the four BCT Options are presented by subcategory in Tables IV-8

TABLE IV-4

GROSS OPERATION AND MAINTENANCE AND ENERGY COSTS AND SAVINGS FOR BCT OPTION 1 PRODUCTION PROCESS CONTROLS FOR MEDIUM SIZED DIRECT DISCHARGERS ($1,000/yr)

Subcategory	Mill Size (kkg/d)	Gross Operation and Maintenance[1]		Gross Energy	
		Cost	Savings	Cost	Savings
Integrated Segment					
Dissolving Kraft	907	368.3	1126.6	494.8	578.4
Market Bleached Kraft	544	186.6	675.2	279.1	215.4
BCT Bleached Kraft	726	245.5	977.0	327.5	235.0
Alkaline-Fine[2]	726	337.2	584.2	189.4	523.8
Unbleached Kraft					
o Linerboard	907	154.9	199.2	180.4	190.6
o Bag					
Semi-Chemical	386	85.3	138.8	65.3	182.1
Unbleached Kraft and Semi-Chemical	1361	247.5	203.3	270.8	221.1
Dissolving Sulfite Pulp	408	682.3	2222.5	1236.6	856.1
Papergrade Sulfite[3]	408	163.3	35.1	151.6	654.9
Groundwood-Thermo-Mechanical					
Groundwood-CMN Papers	544	55.7	199.8	13.6	753.0
Groundwood-Fine Papers	454	76.4	121.6	.8	59.8
Secondary Fibers Segment					
Deink					
o Fine Papers	163	67.1	38.2	7.6	259.0
o Tissue Papers	163	79.6	34.2	11.2	131.3
o Newsprint					
Tissue From Wastepaper	9	9.3	0.8	0.7	4.3
Paperboard From Wastepaper	145	25.8	4.5	.49	172.7
Wastepaper-Molded Products	45	30.8	1.0	5.2	124.1
Builders' Paper and Roofing Felt	204	39.4	19.1	16.4	284.7
Nonintegrated Segment					
Nonintegrated-Fine Papers					
o Wood Fiber Furnish	195	33.0	15.1	5.3	22.8
o Cotton Fiber Furnish	45	19.9	3.5	2.6	5.3
Nonintegrated-Tissue Papers	163	24.5	55.7	4.1	7.8
Nonintegrated-Lightweight Papers	54	24.4	4.2	0.7	110.0
Nonintegrated-Filter and Nonwoven Papers	18	14.0	5.2	0.5	50.1
Nonintegrated-Paperboard	36	3.4	0.27	0.27	17.2

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[1] Excludes energy costs.

[2] Includes Fine Bleached Kraft and Soda subcategories.

[3] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories.

TABLE IV-5

COST ESTIMATING CRITERIA[1]

1.	Capital costs are as of first quarter 1978:		ENR = 2,683
2.	Annual fixed (amortized) costs are 22% of capital expenditures		
3.	Energy:	Electrical	$0.0325/kwh
		Fuel	$12.00/barrel
4.	Operation and Maintenance:		
	Labor:	General	$10.35/hr
		Solids disposal	$ 8.00/hr
	Chemicals:	alum	$110/kkg ($100/t), dry basis
		polymer	$5.51/kg ($2.50/lb)
		85% phosphoric acid	$0.44/kg ($0.20/lb)
		anhydrous ammonia	$154/kkg ($140/t), dry basis
		50% sodium hydroxide	$165/kkg ($150/t)
		100% sulfuric acid	$56/kkg ($51/t)

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[1] Sources of Cost Data:

Employment and Earnings, U.S. Bureau of the Census, April 1978. (19)

Employee Benefits 1977, Chamber of Commerce of the U.S.A., April 1978. (20)

Energy User News, Vol. 3, No. 32, August 7, 1978. (21)

Engineering News Record, March 23, 1978. (22)

Monthly Energy Review, U.S Department of Energy, March 1979. (23)

Municipal Sludge Landfills, EPA-625/1-78-010, U.S. Environmental Protection Agency, Process Design Manual, October 1978. (24)

Chemical Marketing Reporter, November 6, 1978. (25)

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3
DISSOLVING KRAFT SUBCATEGORY

	MILL SIZE T/D (C)	BCT OPTION (B)		
		1	2	3
CAPITAL COST ($1000)	1000	7001	12578	18939
O & M COST ($1000/YR)(D)	1000	-758	4681	4313
ENERGY COST ($1000/YR)(D)	1000	-84	231	213
TOTAL ANNUAL COST ($1000/YR)(D)	1000	1540	7679	8692

(A) All costs are in 1st quarter 1978 dollars.
(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.
(C) Multiply T/D by .907 to obtain kkg/d.
(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING
BCT OPTIONS 1, 2 AND 3
MARKET BLEACHED KRAFT SUBCATEGORY

		BCT OPTION (B)		
MILL SIZE T/D (C)		1	2	3
CAPITAL COST ($1000)	350	2596	5774	7949
	600	3612	7909	10952
	1600	7356	14168	20480
O & M COST ($1000/YR)(D)	350	-263	1503	1356
	600	-489	2350	2117
	1600	-1405	5584	4998
ENERGY COST ($1000/YR)(D)	350	40	75	68
	600	65	117	105
	1600	158	276	246
TOTAL ANNUAL COST ($1000/YR)(D)	350	571	2848	3172
	600	795	4207	4632
	1600	1618	8977	9749

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING
BCT OPTIONS 1, 2 AND 3
BCT BLEACHED KRAFT SUBCATEGORY

		BCT OPTION (B)		
MILL SIZE T/D (C)		1	2	3
CAPITAL COST ($1000)	300	2446	4901	6897
	800	4850	8731	12768
	1300	7308	11666	17868
O & M COST ($1000/YR)(D)	300	-246	1156	1016
	800	-731	2600	2253
	1300	-1214	3981	3426
ENERGY COST ($1000/YR)(D)	300	38	58	51
	800	92	129	112
	1300	145	196	170
TOTAL ANNUAL COST ($1000/YR)(D)	300	538	2292	2584
	800	1067	4649	5174
	1300	1608	6744	7526

(A) All costs are in 1st quarter 1978 dollars.
(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.
(C) Multiply T/D by .907 to obtain kkg/d.
(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3 ALKALINE-FINE SUBCATEGORY

	MILL SIZE T/D (C)	BCT OPTION (B) 1	2	3
CAPITAL COST ($1000)	200	2477	3519	5523
	800	7031	7851	13799
	1200	10714	9981	19305
O & M COST ($1000/YR)(D)	200	-1	775	646
	800	-247	2326	1878
	1200	-459	3306	2649
ENERGY COST ($1000/YR)(D)	200	-64	39	33
	800	-334	115	93
	1200	-559	164	131
TOTAL ANNUAL COST ($1000/YR)(D)	200	545	1588	1894
	800	1547	4168	5007
	1200	2357	5665	7028

(A) All costs are in 1st quarter 1978 dollars.
(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.
(C) Multiply T/D by .907 to obtain kkg/d.
(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3 UNBLEACHED KRAFT SUBCATEGORY LINERBOARD SECTOR

	MILL SIZE T/D (C)	BCT OPTION (B) 1	2	3
CAPITAL COST ($1000)	450	1727	3470	4682
	1000	3441	5490	8111
	1500	5228	6960	11150
O & M COST ($1000/YR)(D)	450	-12	744	609
	1000	-44	1359	1094
	1500	-64	1890	1513
ENERGY COST ($1000/YR)(D)	450	-4	37	31
	1000	-10	68	55
	1500	-16	94	76
TOTAL ANNUAL COST ($1000/YR)(D)	450	380	1545	1670
	1000	757	2635	2934
	1500	1150	3516	4041

(A) All costs are in 1st quarter 1978 dollars.
(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.
(C) Multiply T/D by .907 to obtain kkg/d.
(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3 UNBLEACHED KRAFT SUBCATEGORY BAG AND OTHER PRODUCTS SECTOR

	MILL SIZE T/D (C)	BCT OPTION (B)		
		1	2	3
CAPITAL COST ($1000)	450	1727	3470	4997
	1000	3441	5490	8622
	1500	5228	6960	11802
O & M COST ($1000/YR)(D)	450	-12	744	690
	1000	-44	1359	1257
	1500	-64	1890	1747
ENERGY COST ($1000/YR)(D)	450	-4	37	35
	1000	-10	68	63
	1500	-16	94	87
TOTAL ANNUAL COST ($1000/YR)(D)	450	380	1545	1825
	1000	757	2635	3217
	1500	1150	3516	4431

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3
SEMI-CHEMICAL SUBCATEGORY

	MILL SIZE T/D (C)	BCT OPTION (B)		
		1	2	3
CAPITAL COST ($1000)	200	944	2233	2786
	425	1895	3765	4675
	600	2860	4131	6244
O & M COST ($1000/YR)(D)	200	-7	572	386
	425	-54	486	756
	600	-79	1290	787
ENERGY COST ($1000/YR)(D)	200	-52	21	17
	425	-117	45	28
	600	-167	45	35
TOTAL ANNUAL COST ($1000/YR)(D)	200	208	1084	1016
	425	417	1359	1812
	600	629	2245	2196

(A) All costs are in 1st quarter 1978 dollars.
(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.
(C) Multiply T/D by .907 to obtain kkg/d.
(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING
BCT OPTIONS 1, 2 AND 3
UNBLEACHED KRAFT AND SEMI-CHEMICAL SUBCATEGORY

		BCT OPTION (B)		
	MILL SIZE T/D (C)	1	2	3
CAPITAL COST ($1000)	700	2706	5237	7372
	1500	5499	8159	12745
	2600	7658	11294	17658
O & M COST ($1000/YR)(D)	700	39	1860	1200
	1500	44	3589	3058
	2600	-3	5888	3358
ENERGY COST ($1000/YR)(D)	700	11	64	66
	1500	50	120	151
	2600	80	196	240
TOTAL ANNUAL COST ($1000/YR)(D)	700	646	3076	2888
	1500	1304	5504	6013
	2600	1762	8569	7483

(A) All costs are in 1st quarter 1978 dollars.
(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.
(C) Multiply T/D by .907 to obtain kkg/d.
(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3 DISSOLVING SULFITE PULP SUBCATEGORY NITRATION GRADE

	MILL SIZE T/D (C)	BCT OPTION (B) 1	2	3
CAPITAL COST ($1000)	450	13148	10171	22208
	600	16237	12066	26976
O & M COST ($1000/YR)(D)	450	-1540	4951	4214
	600	-2142	6430	5463
ENERGY COST ($1000/YR)(D)	450	381	168	141
	600	506	217	182
TOTAL ANNUAL COST ($1000/YR)(D)	450	2892	7356	9239
	600	3572	9302	11579

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING
BCT OPTIONS 1, 2 AND 3
DISSOLVING SULFITE PULP SUBCATEGORY
CELLOPHANE GRADE

		BCT OPTION (B)		
	MILL SIZE T/D (C)	1	2	3
CAPITAL COST ($1000)	450	13148	10171	22242
	600	16237	12066	27014
O & M COST ($1000/YR)(D)	450	-1540	4951	4225
	600	-2142	6430	5477
ENERGY COST ($1000/YR)(D)	450	381	168	141
	600	506	217	183
TOTAL ANNUAL COST ($1000/YR)(D)	450	2892	7356	9259
	600	3572	9302	11602

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3 DISSOLVING SULFITE PULP SUBCATEGORY VISCOSE GRADE

MILL SIZE T/D (C)		BCT OPTION (B) 1	2	3
CAPITAL COST ($1000)	450	13148	10171	22212
	600	16237	12066	26984
O & M COST ($1000/YR)(D)	450	-1540	4951	4215
	600	-2142	6430	5466
ENERGY COST ($1000/YR)(D)	450	381	168	141
	600	506	217	182
TOTAL ANNUAL COST ($1000/YR)(D)	450	2892	7356	9242
	600	3572	9302	11584

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3
DISSOLVING SULFITE PULP SUBCATEGORY
ACETATE GRADE

	MILL SIZE T/D (C)	BCT OPTION (B) 1	BCT OPTION (B) 2	BCT OPTION (B) 3
CAPITAL COST ($1000)	450	13148	10749	22889
	600	16237	12745	27778
O & M COST ($1000/YR)(D)	450	-1540	5386	4675
	600	-2142	6994	6059
ENERGY COST ($1000/YR)(D)	450	381	182	157
	600	506	237	203
TOTAL ANNUAL COST ($1000/YR)(D)	450	2892	7933	9866
	600	3572	10035	12373

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3 PAPERGRADE SULFITE (DRUM WASH) SUBCATEGORY AND PAPERGRADE SULFITE (BLOW PIT WASH) SUBCATEGORY

	MILL SIZE T/D (C)	BCT OPTION (B)		
		1	2	3
CAPITAL COST ($1000)	100	1274	2862	3839
	450	3066	6769	9105
	1000	5592	10810	15227
O & M COST ($1000/YR)(D)	100	55	752	654
	450	128	2489	2109
	1000	230	5011	4216
ENERGY COST ($1000/YR)(D)	100	-111	29	25
	450	-503	92	78
	1000	-1123	183	154
TOTAL ANNUAL COST ($1000/YR)(D)	100	280	1411	1523
	450	674	4070	4189
	1000	1230	7572	7720

(A) All costs are in 1st quarter 1978 dollars.
(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.
(C) Multiply T/D by .907 to obtain kkg/d.
(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3
GROUNDWOOD-CMN PAPERS SUBCATEGORY

	MILL SIZE T/D (C)	BCT OPTION (B) 1	2	3
CAPITAL COST ($1000)	50	436	1256	1489
	600	1237	5177	5540
	1000	1939	6980	7725
O & M COST ($1000/YR)(D)	50	2	207	180
	600	-144	1016	801
	1000	-243	1523	1178
ENERGY COST ($1000/YR)(D)	50	-63	13	11
	600	-739	68	53
	1000	-1230	102	78
TOTAL ANNUAL COST ($1000/YR)(D)	50	96	497	518
	600	272	2222	2072
	1000	427	3160	2955

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING
BCT OPTIONS 1, 2 AND 3
GROUNDWOOD-FINE PAPERS SUBCATEGORY

		BCT OPTION (B)		
	MILL SIZE T/D (C)	1	2	3
CAPITAL COST ($1000)	75	819	1505	2098
	500	1698	4531	5451
	750	2476	5728	7238
O & M COST ($1000/YR)(D)	75	12	243	211
	500	-45	832	660
	750	-95	1129	888
ENERGY COST ($1000/YR)(D)	75	-20	15	13
	500	-59	55	43
	750	-140	75	58
TOTAL ANNUAL COST ($1000/YR)(D)	75	180	589	685
	500	374	1884	1903
	750	545	2465	2539

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3
DEINK SUBCATEGORY
FINE PAPERS SECTOR

		BCT OPTION (B)		
	MILL SIZE T/D (C)	1	2	3
CAPITAL COST ($1000)	180	620	2790	2410
	400	996	4426	3799
	800	1501	6615	5688
O & M COST ($1000/YR)(D)	180	29	482	305
	400	80	836	490
	800	166	1409	917
ENERGY COST ($1000/YR)(D)	180	-251	30	18
	400	-174	53	30
	800	-32	92	49
TOTAL ANNUAL COST ($1000/YR)(D)	180	136	1126	853
	400	219	1863	1355
	800	330	2956	2083

(A) All costs are in 1st quarter 1978 dollars.
(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.
(C) Multiply T/D by .907 to obtain kkg/d.
(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING
BCT OPTIONS 1, 2 AND 3
DEINK SUBCATEGORY
TISSUE PAPERS SECTOR

	MILL SIZE T/D (C)	BCT OPTION (B) 1	2	3
CAPITAL COST ($1000)	25	273	934	936
	50	400	1353	1366
	180	814	2790	2764
O & M COST ($1000/YR)(D)	25	18	167	130
	50	25	231	174
	180	45	482	331
ENERGY COST ($1000/YR)(D)	25	-17	9	7
	50	-33	13	10
	180	-120	30	20
TOTAL ANNUAL COST ($1000/YR)(D)	25	61	382	343
	50	88	542	484
	180	179	1126	959

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING
BCT OPTIONS 1, 2 AND 3
TISSUE FROM WASTEPAPER SUBCATEGORY

		BCT OPTION (B)		
	MILL SIZE T/D (C)	1	2	3
CAPITAL COST ($1000)	10	208	562	649
	40	465	1203	1401
O & M COST ($1000/YR)(D)	10	9	108	96
	40	18	198	161
ENERGY COST ($1000/YR)(D)	10	-4	6	5
	40	-15	12	9
TOTAL ANNUAL COST ($1000/YR)(D)	10	51	237	243
	40	105	474	478

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3 PAPERBOARD FROM WASTEPAPER SUBCATEGORY CORRUGATING MEDIUM FURNISH SECTOR

	MILL SIZE T/D (C)	BCT OPTION (B)		
		1	2	3
CAPITAL COST ($1000)	50	331	887	920
	160	572	1685	1659
	700	1703	3794	4148
O & M COST ($1000/YR)(D)	50	13	200	126
	160	21	393	245
	700	57	1091	430
ENERGY COST ($1000/YR)(D)	50	-54	8	5
	160	-172	15	10
	700	-753	39	23
TOTAL ANNUAL COST ($1000/YR)(D)	50	73	403	334
	160	126	779	620
	700	375	1964	1365

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3 PAPERBOARD FROM WASTEPAPER SUBCATEGORY NONCORRUGATING MEDIUM FURNISH SECTOR

		BCT OPTION (B)		
	MILL SIZE T/D (C)	1	2	3
CAPITAL COST ($1000)	50	331	863	912
	160	572	1652	1640
	700	1703	3710	4095
O & M COST ($1000/YR)(D)	50	13	195	124
	160	21	385	241
	700	57	1068	418
ENERGY COST ($1000/YR)(D)	50	-54	8	5
	160	-172	15	9
	700	-753	38	22
TOTAL ANNUAL COST ($1000/YR)(D)	50	73	392	330
	160	126	763	611
	700	375	1922	1341

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3
WASTEPAPER-MOLDED PRODUCTS SUBCATEGORY

	MILL SIZE T/D (C)	BCT OPTION (B)		
		1	2	3
CAPITAL COST ($1000)	20	555	713	919
	50	676	1206	1277
	150	1149	2184	2238
O & M COST ($1000/YR)(D)	20	25	127	81
	50	30	196	114
	150	50	353	183
ENERGY COST ($1000/YR)(D)	20	-46	8	4
	50	-119	12	6
	150	-361	23	11
TOTAL ANNUAL COST ($1000/YR)(D)	20	122	292	287
	50	149	474	401
	150	253	857	687

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3 BUILDERS' PAPER AND ROOFING FELT SUBCATEGORY

		BCT OPTION (B)		
	MILL SIZE T/D (C)	1	2	3
CAPITAL COST ($1000)	100	619	1359	1222
	225	876	2173	1811
O & M COST ($1000/YR)(D)	100	19	217	117
	225	20	348	165
ENERGY COST ($1000/YR)(D)	100	-118	14	6
	225	-268	23	9
TOTAL ANNUAL COST ($1000/YR)(D)	100	136	530	392
	225	193	849	573

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3
NONINTEGRATED-FINE PAPERS SUBCATEGORY
WOOD FIBER FURNISH SECTOR

	MILL SIZE T/D (C)	BCT OPTION (B) 1	 2	 3
CAPITAL COST ($1000)	35	288	843	931
	215	640	2321	2367
	1000	1575	5635	5780
O & M COST ($1000/YR)(D)	35	11	149	129
	215	18	381	280
	1000	20	1107	759
ENERGY COST ($1000/YR)(D)	35	-2	9	7
	215	-17	24	18
	1000	-87	73	50
TOTAL ANNUAL COST ($1000/YR)(D)	35	73	343	341
	215	141	916	818
	1000	347	2419	2081

(A) All costs are in 1st quarter 1978 dollars.
(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.
(C) Multiply T/D by .907 to obtain kkg/d.
(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3
NONINTEGRATED-FINE PAPERS SUBCATEGORY
COTTON FIBER FURNISH SECTOR

	MILL SIZE T/D (C)	BCT OPTION (B) 1	2	3
CAPITAL COST ($1000)	10	192	724	802
	50	375	1771	1855
	100	556	2625	2746
O & M COST ($1000/YR)(D)	10	9	130	123
	50	16	285	252
	100	24	433	372
ENERGY COST ($1000/YR)(D)	10	0	8	6
	50	-3	18	15
	100	-6	28	23
TOTAL ANNUAL COST ($1000/YR)(D)	10	51	297	305
	50	96	693	675
	100	141	1038	1000

(A) All costs are in 1st quarter 1978 dollars.
(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.
(C) Multiply T/D by .907 to obtain kkg/d.
(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3
NONINTEGRATED-FINE PAPERS SUBCATEGORY
COTTON FIBER FURNISH SECTOR

		BCT OPTION (B)		
	MILL SIZE T/D (C)	1	2	3
CAPITAL COST ($1000)	10	192	724	802
	50	375	1771	1855
	100	556	2625	2746
O & M COST ($1000/YR)(D)	10	9	130	123
	50	16	285	252
	100	24	433	372
ENERGY COST ($1000/YR)(D)	10	0	8	6
	50	-3	18	15
	100	-6	28	23
TOTAL ANNUAL COST ($1000/YR)(D)	10	51	297	305
	50	96	693	675
	100	141	1038	1000

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3 NONINTEGRATED-TISSUE PAPERS SUBCATEGORY

	MILL SIZE T/D (C)	BCT OPTION (B) 1	2	3
CAPITAL COST ($1000)	35	206	782(642)	908(783)
	180	415	2180(1778)	2360(1996)
	1000	876	6555(5592)	6703(5815)
O & M COST ($1000/YR)(D)	35	0	64(40)	60(38)
	180	-31	116(75)	107(69)
	1000	-238	276(201)	246(176)
ENERGY COST ($1000/YR)(D)	35	0	12(12)	10(10)
	180	-4	37(59)	33(50)
	1000	-26	159(330)	135(275)
TOTAL ANNUAL COST ($1000/YR)(D)	35	45	248(193)	270(220)
	180	91	633(525)	659(557)
	1000	193	1877(1761)	1856(1731)

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING
BCT OPTIONS 1, 2 AND 3
NONINTEGRATED-LIGHWEIGHT PAPERS SUBCATEGORY
LIGHTWEIGHT PAPERS SECTOR

		BCT OPTION (B)		
	MILL SIZE T/D (C)	1	2	3
CAPITAL COST ($1000)	10	185	568(470)	672(593)
	60	472	1711(1385)	1945(1639)
	200	923	3683(3049)	4073(3516)
O & M COST ($1000/YR)(D)	10	8	55(35)	51(33)
	60	20	101(64)	91(58)
	200	38	172(116)	150(99)
ENERGY COST ($1000/YR)(D)	10	-18	9(7)	7(6)
	60	-109	29(42)	24(33)
	200	-364	75(140)	61(110)
TOTAL ANNUAL COST ($1000/YR)(D)	10	41	189(146)	207(169)
	60	104	506(411)	543(451)
	200	203	1057(927)	1108(983)

(A) All costs are in 1st quarter 1978 dollars.
(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.
(C) Multiply T/D by .907 to obtain kkg/d.
(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING
BCT OPTIONS 1, 2 AND 3
NONINTEGRATED-LIGHTWEIGHT PAPERS SUBCATEGORY
ELECTRICAL PAPERS SECTOR

		BCT OPTION (B)		
	MILL SIZE T/D (C)	1	2	3
CAPITAL COST ($1000)	10	192	749	881
	60	409	2300	2503
	200	837	4961	5363
O & M COST ($1000/YR)(D)	10	9	63	60
	60	20	122	113
	200	42	219	198
ENERGY COST ($1000/YR)(D)	10	-18	12	10
	60	-109	41	37
	200	-363	112	99
TOTAL ANNUAL COST ($1000/YR)(D)	10	42	239	264
	60	90	669	700
	200	184	1422	1477

(A) All costs are in 1st quarter 1978 dollars.
(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.
(C) Multiply T/D by .907 to obtain kkg/d.
(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING
BCT OPTIONS 1, 2 AND 3
NONINTEGRATED-FILTER AND NONWOVEN PAPERS SUBCATEGORY

		BCT OPTION (B)		
	MILL SIZE T/D (C)	1	2	3
CAPITAL COST ($1000)	5	217	432	593
	20	311	1005	1182
	45	424	1668	1851
O & M COST ($1000/YR)(D)	5	8	48	45
	20	9	73	68
	45	7	98	89
ENERGY COST ($1000/YR)(D)	5	-12	7	6
	20	-50	15	13
	45	-112	27	23
TOTAL ANNUAL COST ($1000/YR)(D)	5	48	149	181
	20	68	309	340
	45	93	491	519

(A) All costs are in 1st quarter 1978 dollars.

(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.

(C) Multiply T/D by .907 to obtain kkg/d.

(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-6
MODEL MILL COSTS OF IMPLEMENTING BCT OPTIONS 1, 2 AND 3 NONINTEGRATED-PAPERBOARD SUBCATEGORY

	MILL SIZE T/D (C)	BCT OPTION (B) 1	2	3
CAPITAL COST ($1000)	10	46	260(225)	283(252)
	40	76	601(498)	625(535)
	75	143	880(718)	949(801)
O & M COST ($1000/YR)(D)	10	2	38(26)	37(25)
	40	3	56(36)	53(34)
	75	6	68(43)	65(41)
ENERGY COST ($1000/YR)(D)	10	-4	4(2)	4(2)
	40	-17	9(7)	8(7)
	75	-32	13(14)	12(12)
TOTAL ANNUAL COST ($1000/YR)(D)	10	10	99(77)	103(82)
	40	17	197(153)	199(159)
	75	32	275(215)	286(230)

(A) All costs are in 1st quarter 1978 dollars.
(B) All mills are assumed to meet BPT limits. Therefore, no costs are shown for BPT and cost at the option is increment of cost required to attain the option performance.
(C) Multiply T/D by .907 to obtain kkg/d.
(D) O & M and energy costs are net after deduction of cost savings. Total annual cost is the larger of (O&M cost + energy cost + 22% of capital cost) and (22% of capital cost); i.e., no savings were credited in excess of total O&M and energy expenditures.

TABLE IV-7

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
DISSOLVING KRAFT SUBCATEGORY

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	1000	10346 14316		8126 12096		
O & M COST ($1000/YR)(C)	1000	142 301		522 681		
ENERGY COST ($1000/YR)(C)	1000	741 741		593 593		
TOTAL ANNUAL COST ($1000/YR)(C)	1000	3159 4191		2903 3935		

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for a treatment system type, no mills with that type of system currently exist in this subcategory. Value above line is cost w/o production process controls. Value below is cost with those production process controls necessary to eliminate guideline allowances.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
MARKET BLEACHED KRAFT SUBCATEGORY

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E) 1	ASB Alternative(E) 2	Activated Sludge	Oxidation Pond	Primary Treatment
CAPITAL COST ($1000)	350	3893 5805	7465 9377	3110 5022		
	600	5878 9618	10797 14537	4456 8196		
	1600	12703 18123	21573 26993	8860 14280		
O & M COST ($1000/YR)(C)	350	84 160	442 518	248 324		
	600	107 257	611 760	325 475		
	1600	172 389	1149 1366	555 772		
ENERGY COST ($1000/YR)(C)	350	237 237	242 242	140 140		
	600	408 408	404 404	233 233		
	1600	1105 1105	1048 1048	608 608		
TOTAL ANNUAL COST ($1000/YR)(C)	350	1177 1674	2326 2824	1071 1569		
	600	1808 2781	3390 4362	1538 2511		
	1600	4071 5481	6943 8352	3112 4521		

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for a treatment system type, no mills with that type of system currently exist in this subcategory. Value above line is cost w/o production process controls. Value below is cost with those production process controls necessary to eliminate guideline allowances.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
BCT BLEACHED KRAFT SUBCATEGORY

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E) 1	ASB Alternative(E) 2	Activated Sludge	Oxidation Pond	Primary Treatment
CAPITAL COST ($1000)	300	2980	6521			
		4750	8291			
	800	6214	12677			
		9614	16077			
	1300	9027	17806			
		13707	22486			
O & M COST ($1000/YR)(C)	300	69	477			
		140	548			
	800	107	886			
		243	1022			
	1300	134	1231			
		321	1418			
ENERGY COST ($1000/YR)(C)	300	146	219			
		146	219			
	800	394	559			
		394	559			
	1300	645	898			
		645	898			
TOTAL ANNUAL COST ($1000/YR)(C)	300	871	2131			
		1331	2591			
	800	1867	4234			
		2751	5118			
	1300	2765	6045			
		3982	7262			

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for a treatment system type, no mills with that type of system currently exist in this subcategory. Value above line is cost w/o production process controls. Value below is cost with those production process controls necessary to eliminate guideline allowances.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
ALKALINE-FINE SUBCATEGORY(F)

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E) 1	ASB Alternative(E) 2	Activated Sludge	Oxidation Pond	Primary Treatment
CAPITAL COST ($1000)	200	2015 3005	4719 5709	1938 2928	1568 2558	
	800	5612 9152	11840 15380	4767 8307	4753 8293	
	1200	7651 12331	15667 20347	6306 10986	6574 11254	
O & M COST ($1000/YR)(C)	200	56 95	385 425	183 222	258 297	
	800	101 243	918 1060	368 509	897 1038	
	1200	122 309	1210 1397	459 646	1292 1479	
ENERGY COST ($1000/YR)(C)	200	85 85	137 137	79 79	16 16	
	800	347 347	508 508	291 291	56 56	
	1200	524 524	753 753	432 432	80 80	
TOTAL ANNUAL COST ($1000/YR)(C)	200	585 842	1561 1818	688 946	618 876	
	800	1683 2603	4030 4951	1708 2628	1998 2919	
	1200	2329 3546	5410 6627	2279 3495	2818 4035	

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory. Value above line is cost w/o production process controls. Value below is cost with those production process controls necessary to eliminate guideline allowances.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

(F) Includes Fine Bleached Kraft and Soda Subcategories.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
UNBLEACHED KRAFT SUBCATEGORY
LINERBOARD SECTOR

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	450	2215	4531	3033	1464	
	1000	3888	7662	5119	2772	
	1500	5202	10067	6713	3834	
O & M COST ($1000/YR)(C)	450	64	302	194	238	
	1000	86	472	271	489	
	1500	102	601	325	704	
ENERGY COST ($1000/YR)(C)	450	81	134	91	15	
	1000	180	282	191	30	
	1500	270	413	279	44	
TOTAL ANNUAL COST ($1000/YR)(C)	450	632	1433	953	575	
	1000	1122	2440	1588	1129	
	1500	1516	3229	2081	1592	

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
UNBLEACHED KRAFT SUBCATEGORY
BAG AND OTHER PRODUCTS SECTOR

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	450	2215	4628	2943		
	1000	3888	7802	4987		
	1500	5202	10235	6553		
O & M COST ($1000/YR)(C)	450	64	328	178		
	1000	86	518	245		
	1500	102	663	291		
ENERGY COST ($1000/YR)(C)	450	81	136	91		
	1000	180	284	190		
	1500	270	417	278		
TOTAL ANNUAL COST ($1000/YR)(C)	450	632	1481	916		
	1000	1122	2518	1532		
	1500	1516	3331	2010		

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
SEMI-CHEMICAL SUBCATEGORY

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	200	1168	2610	1728	651	
	425	1962	4233	2792	1190	
	600	2501	5314	3495	1568	
O & M COST ($1000/YR)(C)	200	48	210	144	96	
	425	64	313	194	189	
	600	73	379	224	258	
ENERGY COST ($1000/YR)(C)	200	42	89	47	6	
	425	88	178	91	12	
	600	123	246	124	16	
TOTAL ANNUAL COST ($1000/YR)(C)	200	347	873	571	245	
	425	583	1422	899	462	
	600	746	1794	1117	618	

(A) All costs are in 1st quarter 1978 dollars.
(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.
(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).
(D) Multiply T/D by .907 to obtain kkg/d.
(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
UNBLEACHED KRAFT AND SEMI-CHEMICAL SUBCATEGORY

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E) 1	ASB Alternative(E) 2	Activated Sludge	Oxidation Pond	Primary Treatment
CAPITAL COST ($1000)	700	3397	6619	4355		
	1500	5869	11075	7243		
	2600	8768	16200	10531		
O & M COST ($1000/YR)(C)	700	84	409	255		
	1500	116	642	364		
	2600	149	908	480		
ENERGY COST ($1000/YR)(C)	700	136	229	143		
	1500	287	468	290		
	2600	494	791	486		
TOTAL ANNUAL COST ($1000/YR)(C)	700	967	2094	1357		
	1500	1694	3546	2247		
	2600	2572	5263	3283		

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
DISSOLVING SULFITE PULP SUBCATEGORY
NITRATION GRADE

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	450	7880 10180	14383 16683	6939 9239		
	600	9983 13093	17829 20939	8598 11708		
O & M COST ($1000/YR)(C)	450	146 238	807 899	467 559		
	600	170 295	974 1098	551 675		
ENERGY COST ($1000/YR)(C)	450	825 917	1068 1160	539 631		
	600	1103 1227	1418 1542	717 841		
TOTAL ANNUAL COST ($1000/YR)(C)	450	2704 3394	5039 5729	2533 3223		
	600	3469 4402	6314 7247	3159 4092		

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory. Value above line is cost w/o production process controls. Value below is cost with those production process controls necessary to eliminate guideline allowances.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
DISSOLVING SULFITE PULP SUBCATEGORY
CELLOPHANE GRADE

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	450	7880 10180	14747 17047	6955 9255		
	600	9983 13093	18249 21359	8616 11726		
O & M COST ($1000/YR)(C)	450	146 238	949 1041	475 567		
	600	170 295	1153 1277	561 685		
ENERGY COST ($1000/YR)(C)	450	825 917	1077 1169	539 631		
	600	1103 1227	1431 1556	717 841		
TOTAL ANNUAL COST ($1000/YR)(C)	450	2704 3394	5271 5961	2544 3234		
	600	3469 4402	6599 7532	3173 4106		

(A) All costs are in 1st quarter 1978 dollars.
(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory. Value above line is cost w/o production process controls. Value below is cost with those production process controls necessary to eliminate guideline allowances.
(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).
(D) Multiply T/D by .907 to obtain kkg/d.
(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
DISSOLVING SULFITE PULP SUBCATEGORY
VISCOSE GRADE

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	450	7880 10180	14546 16846	6946 9246		
	600	9983 13093	18016 21126	8606 11716		
O & M COST ($1000/YR)(C)	450	146 238	869 961	470 562		
	600	170 295	1052 1176	555 680		
ENERGY COST ($1000/YR)(C)	450	825 917	1072 1164	539 631		
	600	1103 1227	1424 1548	717 841		
TOTAL ANNUAL COST ($1000/YR)(C)	450	2704 3394	5141 5831	2538 3228		
	600	3469 4402	6439 7372	3165 4098		

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory. Value above line is cost w/o production process controls. Value below is cost with those production process controls necessary to eliminate guideline allowances.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
DISSOLVING SULFITE PULP SUBCATEGORY
ACETATE GRADE

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	450	8488 10788	15875 18175	7454 9754		
	600	10762 13872	19598 22708	9244 12354		
O & M COST ($1000/YR)(C)	450	153 245	1191 1283	509 601		
	600	178 303	1457 1581	603 728		
ENERGY COST ($1000/YR)(C)	450	904 996	1100 1192	590 682		
	600	1209 1333	1462 1586	785 909		
TOTAL ANNUAL COST ($1000/YR)(C)	450	2925 3615	5783 6473	2739 3429		
	600	3755 4688	7230 8163	3422 4355		

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory. Value above line is cost w/o production process controls. Value below is cost with those production process controls necessary to eliminate guideline allowances.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
PAPERGRADE SULFITE SUBCATEGORY (F)(G)

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	100		3223 3973	1357 2107		
	450		9261 11261	3620 5620		
	1000		16780 21240	6359 10819		
O & M COST ($1000/YR)(C)	100		232 262	140 170		
	450		545 625	291 371		
	1000		902 1080	451 629		
ENERGY COST ($1000/YR)(C)	100		153 153	49 49		
	450		652 652	195 195		
	1000		1429 1429	424 424		
TOTAL ANNUAL COST ($1000/YR)(C)	100		1094 1289	487 682		
	450		3234 3754	1283 1803		
	1000		6022 7182	2274 3433		

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory. Value above line is cost w/o production process controls. Value below is cost with those production process controls necessary to eliminate guideline allowances.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

(F) Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) Subcategories.

(G) Costs are based on 52.7 percent sulfite pulp produced on-site.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
GROUNDWOOD CMN PAPERS SUBCATEGORY

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	50	554 964		557 967		
	600	3752 5552		2681 4481		
	1000	5638 8178		3798 6338		
O & M COST ($1000/YR)(C)	50	23 40		69 85		
	600	74 146		216 288		
	1000	96 197		280 382		
ENERGY COST ($1000/YR)(C)	50	22 22		13 13		
	600	265 265		101 101		
	1000	444 444		162 162		
TOTAL ANNUAL COST ($1000/YR)(C)	50	167 274		204 310		
	600	1165 1633		907 1375		
	1000	1780 2441		1278 1939		

(A) All costs are in 1st quarter 1978 dollars.
(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory. Value above line is cost w/o production process controls. Value below is cost with those production process controls necessary to eliminate guideline allowances.
(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).
(D) Multiply T/D by .907 to obtain kkg/d.
(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
GROUNDWOOD-FINE PAPERS SUBCATEGORY

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	75			680 1180		
	500			2258 3978		
	750			2963 4933		
O & M COST ($1000/YR)(C)	75			79 99		
	500			191 260		
	750			234 313		
ENERGY COST ($1000/YR)(C)	75			17 17		
	500			82 82		
	750			118 118		
TOTAL ANNUAL COST ($1000/YR)(C)	75			246 246		
	500			769 1216		
	750			1004 1516		

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory. Value above line is cost w/o production process controls. Value below is cost with those production process controls necessary to eliminate guideline allowances.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
DEINK SUBCATEGORY
FINE PAPERS SECTOR

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	180		418	1812		
	400		703	2873		
	800		1143	4342		
O & M COST ($1000/YR)(C)	180		66	192		
	400		105	300		
	800		161	454		
ENERGY COST ($1000/YR)(C)	180		14	33		
	400		31	65		
	800		64	121		
TOTAL ANNUAL COST ($1000/YR)(C)	180		171	624		
	400		291	997		
	800		477	1530		

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
DEINK SUBCATEGORY
TISSUE PAPERS SECTOR

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E) 1	ASB Alternative(E) 2	Activated Sludge	Oxidation Pond	Primary Treatment
CAPITAL COST ($1000)	25		147	602		
	50		203	864		
	180		418	1749		
O & M COST ($1000/YR)(C)	25		24	72		
	50		34	97		
	180		66	183		
ENERGY COST ($1000/YR)(C)	25		2	8		
	50		4	13		
	180		15	34		
TOTAL ANNUAL COST ($1000/YR)(C)	25		59	212		
	50		82	300		
	180		172	602		

(A) All costs are in 1st quarter 1978 dollars.
(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.
(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).
(D) Multiply T/D by .907 to obtain kkg/d.
(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
TISSUE FROM WASTEPAPER SUBCATEGORY

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	10					
	40					
O & M COST ($1000/YR)(C)	10					
	40					
ENERGY COST ($1000/YR)(C)	10	BCT OPTION 4 IS IDENTICAL TO BCT OPTION 1 FOR THIS SUBCATEGORY. THERE ARE NO TREATMENT SYSTEM MODIFICATIONS FOR BCT OPTION 1. SEE TABLE IV-6 FOR MODEL MILL COSTS.				
	40					
TOTAL ANNUAL COST ($1000/YR)(C)	10					
	40					

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
PAPERBOARD FROM WASTEPAPER SUBCATEGORY

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	50					
	160					
	700					
O & M COST ($1000/YR)(C)	50					
	160					
	700					
ENERGY COST ($1000/YR)(C)	50					
	160					
	700					
TOTAL ANNUAL COST ($1000/YR)(C)	50					
	160					
	700					

BCT OPTION 4 IS IDENTICAL TO BCT OPTION 1 FOR THIS SUBCATEGORY. THERE ARE NO TREATMENT SYSTEM MODIFICATIONS FOR BCT OPTION 1. SEE TABLE IV-6 FOR MODEL MILL COSTS.

(A) All costs are in 1st quarter 1978 dollars.
(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.
(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).
(D) Multiply T/D by .907 to obtain kkg/d.
(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
WASTEPAPER-MOLDED PRODUCTS SUBCATEGORY

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	50					
	160					
	700					
O & M COST ($1000/YR)(C)	50					
	160	BCT OPTION 4 IS IDENTICAL TO BCT OPTION 1 FOR THIS SUBCATEGORY. THERE ARE NO TREATMENT SYSTEM MODIFICATIONS FOR BCT OPTION 1. SEE TABLE IV-6 FOR MODEL MILL COSTS.				
	700					
ENERGY COST ($1000/YR)(C)	50					
	160					
	700					
TOTAL ANNUAL COST ($1000/YR)(C)	50					
	160					
	700					

(A) All costs are in 1st quarter 1978 dollars.
(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.
(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).
(D) Multiply T/D by .907 to obtain kkg/d.
(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
BUILDERS' PAPER & ROOFING FELT SUBCATEGORY

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	20					
	50					
	150					
O & M COST ($1000/YR)(C)	20					
	50					
	150					
ENERGY COST ($1000/YR)(C)	20					
	50					
	150					
TOTAL ANNUAL COST ($1000/YR)(C)	20					
	50					
	150					

BCT OPTION 4 IS IDENTICAL TO BCT OPTION 1 FOR THIS SUBCATEGORY. THERE ARE NO TREATMENT SYSTEM MODIFICATIONS FOR BCT OPTION 1. SEE TABLE IV-6 FOR MODEL MILL COSTS.

(A) All costs are in 1st quarter 1978 dollars.
(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.
(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).
(D) Multiply T/D by .907 to obtain kkg/d.
(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
NONINTEGRATED-FINE PAPERS SUBCATEGORY
WOOD FIBER FURNISH SECTOR

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	35	257				
	215	873				
	1000	2542				
O & M COST ($1000/YR)(C)	35	29				
	215	47				
	1000	78				
ENERGY COST ($1000/YR)(C)	35	5				
	215	29				
	1000	139				
TOTAL ANNUAL COST ($1000/YR)(C)	35	90				
	215	268				
	1000	776				

(A) All costs are in 1st quarter 1978 dollars.
(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.
(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).
(D) Multiply T/D by .907 to obtain kkg/d.
(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
NONINTEGRATED-FINE PAPERS SUBCATEGORY
COTTON FIBER FURNISH SECTOR

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E) 1	ASB Alternative(E) 2	Activated Sludge	Oxidation Pond	Primary Treatment
CAPITAL COST ($1000)	10	221		451		
	50	649		1168		
	100	1043		2182		
O & M COST ($1000/YR)(C)	10	27		68		
	50	41		159		
	100	51		349		
ENERGY COST ($1000/YR)(C)	10	4		8		
	50	19		30		
	100	38		59		
TOTAL ANNUAL COST ($1000/YR)(C)	10	80		175		
	50	203		446		
	100	318		888		

(A) All costs are in 1st quarter 1978 dollars.
(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.
(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).
(D) Multiply T/D by .907 to obtain kkg/d.
(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
NONINTEGRATED-TISSUE PAPERS SUBCATEGORY

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E) 1	ASB Alternative(E) 2	Activated Sludge	Oxidation Pond	Primary Treatment
CAPITAL COST ($1000)	35					569
	180					1357
	1000					3575
O & M COST ($1000/YR)(C)	35					157
	180					373
	1000					1265
ENERGY COST ($1000/YR)(C)	35					4
	180					15
	1000					76
TOTAL ANNUAL COST ($1000/YR)(C)	35					286
	180					686
	1000					2127

(A) All costs are in 1st quarter 1978 dollars.
(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.
(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).
(D) Multiply T/D by .907 to obtain kkg/d.
(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
NONINTEGRATED-LIGHTWEIGHT PAPERS SUBCATEGORY
LIGHTWEIGHT PAPERS SECTOR

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	10					442
	60					1124
	200					2189
O & M COST ($1000/YR)(C)	10					127
	60					303
	200					661
ENERGY COST ($1000/YR)(C)	10					2
	60					11
	200					33
TOTAL ANNUAL COST ($1000/YR)(C)	10					227
	60					561
	200					1176

(A) All costs are in 1st quarter 1978 dollars.
(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.
(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).
(D) Multiply T/D by .907 to obtain kkg/d.
(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
NONINTEGRATED-LIGHTWEIGHT PAPERS SUBCATEGORY
ELECTRICAL PAPERS SECTOR

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E) 1	ASB Alternative(E) 2	Activated Sludge	Oxidation Pond	Primary Treatment
CAPITAL COST ($1000)	10					558
	60					1447
	200					2849
O & M COST ($1000/YR)(C)	10					154
	60					401
	200					931
ENERGY COST ($1000/YR)(C)	10					3
	60					17
	200					52
TOTAL ANNUAL COST ($1000/YR)(C)	10					281
	60					736
	200					1610

(A) All costs are in 1st quarter 1978 dollars.
(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.
(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).
(D) Multiply T/D by .907 to obtain kkg/d.
(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
NONINTEGRATED-FILTER AND NONWOVEN PAPERS SUBCATEGORY

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E) 1	ASB Alternative(E) 2	Activated Sludge	Oxidation Pond	Primary Treatment
CAPITAL COST ($1000)	5					348
	20					700
	45					1077
O & M COST ($1000/YR)(C)	5					105
	20					189
	45					290
ENERGY COST ($1000/YR)(C)	5					2
	20					5
	45					10
TOTAL ANNUAL COST ($1000/YR)(C)	5					183
	20					348
	45					537

(A) All costs are in 1st quarter 1978 dollars.
(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.
(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).
(D) Multiply T/D by .907 to obtain kkg/d.
(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-7 (continued)

MODEL MILL COSTS OF IMPLEMENTING BCT OPTION 4
COSTS FOR MODIFICATION OF TREATMENT SYSTEM
NONINTEGRATED-PAPERBOARD SUBCATEGORY

	Model Mill Size(D) (ton/day)	Costs for Modification to Treatment Systems(A)(B)				
		ASB Alternative(E)		Activated Sludge	Oxidation Pond	Primary Treatment
		1	2			
CAPITAL COST ($1000)	10					235
	40					465
	75					643
O & M COST ($1000/YR)(C)	10					78
	40					130
	75					171
ENERGY COST ($1000/YR)(C)	10					1
	40					2
	75					4
TOTAL ANNUAL COST ($1000/YR)(C)	10					131
	40					235
	75					317

(A) All costs are in 1st quarter 1978 dollars.

(B) If no cost is indicated for treatment system type, no mills with that type of system currently exist in this subcategory.

(C) O & M and energy costs are net after deduction of cost savings. Total annual cost includes: O & M + energy + fixed annual costs (22% of capital cost).

(D) Multiply T/D by .907 to obtain kkg/d.

(E) 1 = Additional aeration and settling. 2 = Conversion to extended aeration.

TABLE IV-8
PULP, PAPER AND PAPERBOARD INDUSTRY
BPT COSTS OF IMPLEMENTATION,
BPT ANNUAL AVERAGE POLLUTANT REMOVALS,
AND BPT COST EFFECTIVENESS

Subcategory	BPT Costs (a)		Total Annual Average Pollutant Removals (1000 lb/yr)(b)			Cost Effectiveness
	Capital ($1,000)	Total Annual ($1,000/yr)	BOD	TSS	Total	($/lb)(c)
Integrated Segment						
Dissolving Kraft	108200	32800	121136	184681	305817	.107
Market Bleached Kraft	268300	77400	208994	224926	433920	.178
BCT Bleached Kraft	233200	64600	217398	375936	593334	.109
Alkaline Fine	342600	97600	227904	495686	723590	.135
Unbleached Kraft	433400	147900	294943	325565	620508	.238
Linerboard	273100	93100	216920	255752	472671	.197
Bag	133800	45900	78024	69813	147837	.310
Semi-Chemical	148200	62100	138149	56474	194624	.319
Unbleached Kraft and Semi-Chemical	171900	60100	178916	177873	356789	.168
Dissolving Sulfite Pulp	170400	63000	325656	123363	449019	.140
Papergrade Sulfite	285000	98500	193960	185318	379278	.260
Groundwood-Thermo-Mechanical (d)	—	—	—	—	—	—
Groundwood-CMN Papers	36300	10000	16777	49394	66171	.151
Groundwood-Fine Papers	83900	23900	37183	124492	161675	.148
Secondary Fibers Segment						
Deink	151300	45800	146720	373219	519939	.088
Fine Papers	36100	10800	25178	59778	84956	.127
Tissue Papers	115200	35000	121542	313441	434983	.080
Tissue From Wastepaper	32100	9500	2665	26762	29427	.323
Paperboard From Wastepaper	40323	11152	61528	34841	96368	.116
Wastepaper-Molded Products	9600	3100	1083	1904	2988	1.038
Builders' Paper And Roofing Felt	8100	2600	4227	15261	19488	.133
Nonintegrated Segment						
Nonintegrated-Fine Papers	84600	23200	25073	82008	107081	.217
Wood Fiber Segment	80400	22100	23877	78779	102656	.215
Cotton Fiber Segment	4200	1100	1196	3229	4425	.249
Nonintegrated-Tissue Papers	32300	9200	6558	26273	32831	.280
Nonintegrated-Lightweight Papers	37400	10500	6166	24997	31162	.337
Lightweight	32900	9100	5986	24027	30012	.303
Electrical	4500	1400	180	970	1150	1.218
Nonintegrated-Filter And Nonwoven Papers	9500	2800	209	1346	1554	1.802
Nonintegrated-Paperboard	8200	2500	1375	5735	7110	.352

(a) All costs are in first quarter 1978 dollars, ENR Index 2683.
(b) Pollutant removals are the quantity of pollutants to be removed to achieve BPT final effluent levels from BPT raw waste loads.
(c) Total annual cost ($)/total annual average pollutants removed(lb).
(d) BCT has been set equal to BPT for this subcategory.

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TABLE IV-9
PULP, PAPER AND PAPERBOARD INDUSTRY
BCT OPTION 1 COST OF IMPLEMENTATION, BCT OPTION 1 ANNUAL AVERAGE POLLUTANT REMOVALS, AND BCT OPTION 1 COST EFFECTIVENESS

Subcategory	BCT OPTION 1 (a)		Total Annual Average Pollutant Removals (lb/yr)(b)			Cost Effectiveness	
	Capital Cost ($1,000)	Total Annual Cost ($1,000/yr)	BOD	TSS	Total	BCT Option 1 ($/lb) (c)	Industry Comparison BCT/BPT (d)
Integrated Segment							
Dissolving Kraft	23867	5251	1915154	624623	2539777	2.068	19.277
Market Bleached Kraft	49834	10963	5310758	11246310	16557068	.662	3.712
BCT Bleached Kraft	47912	10541	3164448	4430227	7594675	1.388	12.748
Alkaline Fine	103032	22667	1438659	10817875	12256534	1.849	13.711
Unbleached Kraft	85988	18922	3484793	15899156	19383949	.976	4.095
Linerboard	65478	14405	2734113	13888826	16622939	.867	4.400
Bag	20510	4517	750680	2010330	2761010	1.636	5.269
Semi-Chemical	39064	8594	6679750	6376125	13055875	.658	2.063
Unbleached Kraft and Semi-Chemical	45316	10483	7824317	8867559	16691875	.628	3.728
Dissolving Sulfite Pulp	71046	15630	9024614	13376741	22401355	.698	4.988
Papergrade Sulfite	31002	6821	4743000	8690313	13433313	.508	1.955
Groundwood-Thermo-Mechanical(e)	0	0	0	0	0	--	--
Groundwood-CMN Papers	3526	776	717452	607075	1324526	.586	3.877
Groundwood-Fine Papers	12752	2805	1395939	1269035	2664974	1.053	7.120
Secondary Fibers Segment							
Deink	10616	2337	4055557	5483886	9539443	.245	2.781
Fine Papers	2226	490	1034577	1144993	2179570	.225	1.768
Tissue Papers	8390	1847	3020980	4338893	7359873	.251	3.119
Tissue From Wastepaper	4019	915	685238	558342	1243581	.736	2.279
Paperboard From Wastepaper	19867	4371	1080314	2516817	3597131	1.215	10.500
Wastepaper-Molded Products	2974	654	114908	336516	451424	1.449	1.396
Builders' Paper and Roofing Felt	3120	686	445995	349040	795035	.863	6.467
Nonintegrated Segment							
Nonintegrated-Fine Papers	10687	2441	2664270	4294115	6958385	.351	1.619
Wood Fiber Furnish	9931	2246	2573550	4146275	6719825	.334	1.553
Cotton Fiber Furnish	756	195	90720	147840	238560	.817	3.288
Nonintegrated-Tissue Papers	3510	777	494947	412456	907403	.856	3.056
Nonintegrated-Lightweight	5330	1174	653941	543902	1197844	.980	2.909
Lightweight	4525	995	627876	523230	1151106	.864	2.851
Electrical	805	179	26065	20672	46738	3.830	3.145
Nonintegrated-Filter and Nonwoven Papers	1400	308	121104	97556	218660	1.409	.782
Nonintegrated-Paperboard	597	131	40673	32538	73211	1.789	5.089

(a) All costs are in first quarter 1978 dollars, ENR Index 2683.
(b) Pollutant removals are the quantity of pollutants to be removed to achieve BCT Option 1 final effluent levels from BPT final effluent levels.
(c) Total annual cost ($)/total annual average pollutants removed (lb).
(d) BCT Option 1 ($/lb)/BPT ($/lb).
(e) BCT has been set equal to BPT for this subcategory.

TABLE IV-10
PULP, PAPER AND PAPERBOARD INDUSTRY
BCT OPTION 2 COST OF IMPLEMENTATION, BCT OPTION 2 ANNUAL AVERAGE POLLUTANT REMOVALS, AND BCT OPTION 2 COST EFFECTIVENESS

	BCT OPTION 2 (a)		Total Annual Average Pollutant Removals (lb/yr)(b)			Cost Effectiveness	
Subcategory	Capital Cost ($1,000)	Total Annual Cost ($1,000/yr)	BOD	TSS (e)	Total	BCT Option 2 ($/lb) (c)	Industry Comparison BCT/BPT (d)
Integrated Segment							
Dissolving Kraft	38948	24006	5580103	12575875	18155978	1.322	12.328
Market Bleached Kraft	105372	60502	11207803	29135440	40343243	1.500	8.408
BCT Bleached Kraft	85868	46875	9433182	21578687	31011869	1.512	13.883
Alkaline Fine	117034	62492	10681053	27009312	37690365	1.658	12.292
Unbleached Kraft	134117	64123	13283795	35007000	48290795	1.328	5.570
Linerboard	101576	48959	9857540	27500200	37357740	1.311	6.654
Bag	32541	15164	3426255	7506800	10933055	1.387	4.467
Semi-Chemical	64782	29462	7235601	11697001	18932602	1.556	4.877
Unbleached Kraft and Semi-Chemical	75920	52216	10256677	20765736	31022413	1.683	9.992
Dissolving Sulfite Pulp	55415	41454	13488118	25305056	38793174	1.069	7.639
Papergrade Sulfite	66576	44494	8897603	16544874	25442477	1.749	6.674
Groundwood-Thermo-Mechanical (f)	0	0	0	0	0	—	—
Groundwood-CMN Papers	13271	5734	653670	1400521	2054191	2.791	18.471
Groundwood-Fine Papers	30213	12872	1321237	2961737	4282974	3.005	20.330
Secondary Fibers Segment							
Deink	37822	15725	4670704	8237650	12908354	1.218	13.830
Fine Papers	8590	3498	917331	1597146	2514477	1.391	10.943
Tissue Papers	29232	12227	3753374	6640504	10393878	1.176	14.620
Tissue From Wastepaper	11205	4396	375101	614913	990013	4.440	13.754
Paperboard From Wastepaper	53035	25318	1948935	3775225	5724160	4.423	38.221
Wastepaper-Molded Products	5118	1948	47301	164207	211508	9.210	8.876
Builders' Paper and Roofing Felt	7386	2853	65455	57708	123163	23.164	173.627
Nonintegrated Segment							
Nonintegrated-Fine Papers	37570	15075	2778099	4946354	7724454	1.952	9.008
Wood Fiber Furnish	34163	13716	2676005	4762211	7438216	1.844	8.565
Cotton Fiber Furnish	3407	1359	102094	184143	286238	4.748	19.100
Nonintegrated-Tissue Papers	16175	4781	1548046	0	1548046	3.088	11.021
Nonintegrated-Lightweight	18772	5511	1742922	0	1742922	3.162	9.384
Lightweight	16745	4863	1631497	0	1631497	2.981	9.831
Electrical	2027	648	111425	0	111425	5.816	4.775
Nonintegrated-Filter and Nonwoven Papers	4843	1444	323192	0	323192	4.468	2.480
Nonintegrated-Paperboard	3689	1150	168469	0	168469	6.826	19.412

(a) All costs are in first quarter 1978 dollars, ENR Index 2683.
(b) Pollutant removals are the quantity of pollutants to be removed to achieve BCT Option 2 final effluent levels from BPT final effluent levels.
(c) Total annual cost ($)/total annual average pollutants removed (lb).
(d) BCT Option 2 ($/lb)/BPT ($/lb).
(e) Negative pounds removed have been set equal to zero.
(f) BCT has been set equal to BPT for this subcategory.

TABLE IV-11
PULP, PAPER AND PAPERBOARD INDUSTRY
BCT OPTION 3 COST OF IMPLEMENTATION, BCT OPTION 3 ANNUAL AVERAGE POLLUTANT REMOVALS, AND BCT OPTION 3 COST EFFECTIVENESS

Subcategory	BCT OPTION 3 (a) Capital Cost ($1,000)	BCT OPTION 3 (a) Total Annual Cost ($1,000/yr)	Total Annual Average Pollutant Removals (lb/yr)(b) BOD	Total Annual Average Pollutant Removals (lb/yr)(b) TSS (e)	Total Annual Average Pollutant Removals (lb/yr)(b) Total	Cost Effectiveness BCT Option 3 ($/lb) (c)	Cost Effectiveness Industry Comparisen BCT/BPT (d)
Integrated Segment							
Dissolving Kraft	61015	27760	6329650	13616558	19946208	1.392	12.976
Market Bleached Kraft	147994	65161	13036790	32066510	45103300	1.445	8.099
BCT Bleached Kraft	126347	52787	11990518	25339476	37329993	1.414	12.988
Alkaline Fine	202873	73843	14962886	33636134	48599021	1.519	11.265
Unbleached Kraft	200940	73254	16374960	39435165	55810125	1.313	5.507
Linerboard	151296	55307	12505115	31451525	43956640	1.258	6.388
Bag	49644	17947	3869845	7983640	11853485	1.514	4.877
Semi-Chemical	90340	33226	9461433	13596176	23057609	1.441	4.516
Unbleached Kraft and Semi-Chemical	110514	48794	12616726	23484686	36101412	1.352	8.024
Dissolving Sulfite Pulp	120614	51560	15321710	27101038	42422749	1.215	8.688
Papergrade Sulfite	90386	45085	10815184	21384880	32200063	1.400	5.391
Groundwood-Thermo-Mechanical (f)	0	0	0	0	0	—	—
Groundwood-CMN Papers	14680	5507	1175620	2205999	3381618	1.629	10.776
Groundwood-Fine Papers	38017	13240	2435706	4681597	7117303	1.860	12.584
Secondary Fibers Segment							
Deink	36587	12944	7224644	10756448	17981092	.720	8.172
Fine Papers	7762	2718	1510147	2189962	3700109	.735	5.778
Tissue Papers	28825	10226	5714497	8566486	14280983	.716	8.899
Tissue From Wastepaper	12703	4367	601156	850387	1451543	3.009	9.319
Paperboard From Wastepaper	54907	19494	3385438	5289574	8675012	2.247	19.418
Wastepaper-Molded Products	5492	1704	168530	427748	596278	2.858	2.754
Builders' Paper and Roofing Felt	6364	2050	547952	530744	1078696	1.900	14.245
Nonintegrated Segment							
Nonintegrated-Fine Papers	38570	13740	4438835	6753113	11191948	1.228	5.666
Wood Fiber Furnish	35000	12428	4273598	6491208	10764806	1.155	5.363
Cotton Fiber Furnish	3570	1312	165237	261905	427143	3.072	12.356
Nonintegrated-Tissue Papers	17691	5076	1816253	0	1816253	2.795	9.974
Nonintegrated-Lightweight	21206	5941	2117543	0	2117543	2.806	8.327
Lightweight	18539	5165	1989742	0	1989742	2.596	8.561
Electrical	2667	776	127801	0	127801	6.072	4.986
Nonintegrated-Filter and Nonwoven Papers	5498	1555	391662	0	391662	3.970	2.204
Nonintegrated-Paperboard	3926	1194	193394	0	193394	6.174	17.558

(a) All costs are in first quarter 1978 dollars, ENR Index 2683.
(b) Pollutant removals are the quantity of pollutants to be removed to achieve BCT Option 3 final effluent levels from BPT final effluent levels.
(c) Total annual cost ($)/total annual average pollutants removed (lb).
(d) BCT Option 3 ($/lb)/BPT ($/lb).
(e) Negative pounds removed have been set equal to zero.
(f) BCT has been set equal to BPT for this subcategory.

TABLE IV-12
PULP, PAPER AND PAPERBOARD INDUSTRY
BCT OPTION 4 COST OF IMPLEMENTATION,
BCT OPTION 4 ANNUAL AVERAGE POLLUTANT REMOVALS,
AND BCT OPTION 4 COST EFFECTIVENESS

Subcategory	BCT OPTION 4 (a) Capital Cost ($1,000)	BCT OPTION 4 (a) Total Annual Cost ($1,000/yr)	Total Annual Average Pollutant Removals (lb/yr)(b) BOD	Total Annual Average Pollutant Removals (lb/yr)(b) TSS	Total Annual Average Pollutant Removals (lb/yr)(b) Total	Cost Effectiveness BCT Option 4 ($/lb) (c)	Cost Effectiveness Industry Comparison BCT/BPT (d)
Integrated Segment							
Dissolving Kraft	30051	9641	4871843	10368521	15240363	.633	5.898
Market Bleached Kraft	85999	28009	7497540	20618235	28115775	.996	5.585
BCT Bleached Kraft	85786	27511	8860454	17720909	26581363	1.035	9.506
Alkaline Fine	96233	32910	10423494	27740698	38164192	.862	6.393
Unbleached Kraft	99949	31806	6538693	16508538	23047231	1.380	5.790
Linerboard	76430	24602	4899363	14015523	18914886	1.301	6.604
Bag	23519	7204	1639330	2493015	4132345	1.743	5.615
Semi-Chemical	54912	17845	7590625	4858000	12448625	1.433	4.493
Unbleached Kraft and Semi-Chemical	64996	19633	9389180	11475664	20864844	.941	5.586
Dissolving Sulfite Pulp	47327	17060	10851425	15630135	26481560	.644	4.605
Papergrade Sulfite	45589	16008	8393725	14090517	22484242	.712	2.741
Groundwood-Thermo-Mechanical (e)	0	0	0	0	0	—	—
Groundwood-CMN Papers	7719	2527	772640	1710847	2483487	1.018	6.733
Groundwood-Fine Papers	15377	5250	1649746	3680202	5329947	.985	6.663
Secondary Fibers Segment							
Deink	18266	6784	4055557	5483886	9539443	.711	8.073
Fine Papers	3484	1300	1034577	1144993	2179570	.596	4.692
Tissue Papers	14782	5484	3020980	4338893	7359873	.745	9.260
Tissue From Wastepaper	4019	915	685238	558342	1243581	.736	2.279
Paperboard From Wastepaper	19867	4371	1080314	2516817	3597131	1.215	10.500
Wastepaper-Molded Products	2974	654	114908	336516	451424	1.449	1.396
Builders' Paper and Roofing Felt	3120	686	445995	349040	795035	.863	6.467
Nonintegrated Segment							
Nonintegrated-Fine Papers	17644	6164	3000620	4963455	7964075	.774	3.572
Wood Fiber Furnish	16170	5643	2859500	4718175	7577675	.745	3.459
Cotton Fiber Furnish	1474	521	141120	245280	386400	1.348	5.424
Nonintegrated-Tissue Papers	10804	5480	618684	742421	1361105	4.026	14.368
Nonintegrated-Lightweight	12448	6349	693745	849238	1542983	4.115	12.212
Lightweight	10894	5561	648805	795310	1444115	3.851	12.700
Electrical	1554	788	44940	53928	98868	7.970	6.544
Nonintegrated-Filter and Nonwoven Papers	3340	1645	131196	158108	289304	5.686	3.156
Nonintegrated-Paperboard	2926	1478	65076	81345	146421	10.094	28.706

(a) All costs are in first quarter 1978 dollars, ENR Index 2683.
(b) Pollutant removals are the quantity of pollutants to be removed to achieve BCT Option 4 final effluent levels from BPT final effluent levels.
(c) Total annual cost ($)/total annual average pollutants removed (lb).
(d) BCT Option 4 ($/lb)/BPT ($/lb).
(e) BCT has been set equal to BPT for this subcategory.

through Table IV-12. The costs of implementation of BPT are included because they are one of the bases for the "cost reasonableness tests" as explained in Section II. Model mill costs for attainment of BPT final effluent levels from BPT RWLs are taken from previous development documents adjusted to first quarter 1978 dollars, as necessary, and used in conjunction with actual mill production to estimate the total subcategory costs presented in Table IV-8. The BCT costs represent the incremental costs of attaining BCT final effluent levels from BPT final effluent levels. The development of the costs of implementation of BCT Options 1, 2, 3 and 4 are discussed briefly below.

In addition to subcategory costs, Tables IV-8 through IV-12 present total annual average pollutant removals by subcategory. The BPT pollutant removals are the pounds of BOD5 and TSS that must be removed to attain BPT final effluent levels from BPT RWLs. The BCT pollutant removals are the incremental pounds of BOD5 and TSS that must be removed to attain the various BCT final effluent levels from BPT final effluent levels.

Tables IV-8 through IV-12 also present cost effectiveness ratios for the two "cost reasonableness tests" by subcategory. The first of these ratios, the cost in dollars per pound of pollutant removed ($/lb) is presented for BPT and BCT options 1, 2, 3, and 4. The second, the industry comparison test, is the ($/lb) for each of the BCT options divided by the ($/lb) for BPT and is presented for each BCT option.

Option 1. This option involves the application of production process controls to reduce RWLs and the application of end-of-pipe treatment identical to that which formed the basis of BPT effluent limitations guidelines. As discussed earlier, the implementation of production process controls can result in material and energy savings. EPA estimated the economic savings associated with the production process controls that form the basis of BCT Option 1. These estimates are presented in Table IV-4. Improved by-product recovery may also result; however, no estimates of savings resulting from by-product recovery were included in the figures presented in Table IV-4.

For BCT Option 1, the costs of installation of each process control were developed for several model sizes in terms of parameters that are the normal measure of size for the various controls (flow, volume, etc.). Costs were usually developed for one to three model sizes reflecting the range of equipment size found in the pulp and paper industry. Generalized cost equations representing capital costs of installation, energy usage and energy savings, and other operation and maintenance costs and savings for each control, were developed as functions of size from the different model sizes.

The capital cost equations represented the costs of installation of a single unit of a control. A single unit of some controls such as liquor preparation area spill collection systems would normally be installed at a mill; however, other controls such as fourth stage brown stock washers would be installed in multiples, one in each pulp washing line at a mill. Thus, the cost of installation of some controls is not only a function of mill size but of the number of units of the control required for the mill.

The generalized cost equations for each control were next adapted for use in the specific subcategories for which the controls were required. The cost of implementation of BCT Option 1 for mills in each subcategory is estimated by summing the cost equations for each BCT Option 1 control appropriate for that subcategory. The sum may be considered a complex subcategory cost equation. The total model mill cost estimates are functions of parameters such as the quantity of paper produced, quantity of pulp produced, number of washer lines, number of bleach lines, number of evaporators, and the number of paper machines at each individual mill.

The model mill costs presented in Table IV-6 are derived from the subcategory cost equations at the model mill. The other parameters used for the subcategory model mills are presented in Table IV-2. The total estimated costs of the implementation of BCT Option 1 for each subcategory, as shown in Table IV-9, were based on the model subcategory cost equations, EPA's estimated production for actual mills in each subcategory, and values of other relevant parameters for each mill taken from the surveys and questionnaires discussed previously.

Example calculations for the costs of BCT Option 1 production process controls for an alkaline-fine model mill are presented in Table IV-13.

Option 2. BCT Option 2 consists of BPT technology plus the addition of chemically assisted clarification for all integrated and secondary fiber subcategories and for the nonintegrated-fine papers subcategory (the subcategories for which biological treatment is the technology basis for BPT). In the remaining nonintegrated subcategories, for which primary treatment is the technology basis for BPT, Option 2 is identified as BPT technology plus the addition of biological treatment.

The costs for the chemically assisted clarification system are based on the following items:

1. wastewater pumping,
2. sulfuric acid feed system,
3. chemically assisted clarification (solids contact clarifier),
4. chemical coagulation with alum (at a dosage appropriate for each subcategory) and polyelectrolyte addition (at 1 mg/l),
5. neutralization with 10 mg/l sodium hydroxide,
6. solids dewatering,
7. dissolved air flotation thickening,
8. chemical sludge transportation to landfill, and
9. chemical sludge landfill.

TABLE IV-13

BCT OPTION 1 PRODUCTION PROCESS CONTROLS SAMPLE COST CALCULATIONS
725 kkg/d Alkaline-Fine Mill

A. Capital Costs			B. Energy and Other O&M Costs				
Item No.	Item	Cost	Increase in Electricity Use ($/yr)	Increase in Steam Use ($/yr)	Chemical (Savings) ($/yr)	Stock (Savings) ($/yr)	Contractor Costs ($/yr)
1	Seggregate Woodroom Cooling Water	31,800	1,800	--	--	--	--
2	Addition of Fourth Stage Brown Stock Washer	2,474,400	112,700	(32,400)	(102,200)	--	--
3	Spill Collection for Pulp Mill Brown Stock	332,600	5,500	(21,800)	--	(105,600)	--
4	Full Countercurrent Washing in Bleachery	2,698,000	--	(404,000)	--	--	--
5	Spill Collection for Evaporation and Recovery and Liquor Preparation Areas	402,100	4,800	22,000	(27,900)	--	--
6	Causticizing Area Spill Collection	273,400	4,000	(10,900)	(339,500)	--	--
7	Paper Machine Spill Collection	512,700	6,800	(29,100)	--	(9,000)	--
8	Color Plant Spill Collection	66,100	2,500	--	--	--	--
9	White Water for Vacuum Pump Seals	67,500	--	--	--	--	--
10	Reuse Vacuum Pump Water	116,700	--	--	--	--	--
11	Boiler Blowdown and Backwash Lagoon	55,700	3,800	--	--	--	20,800
		7,031,000	141,900	(476,200)	(469,600)	(114,600)	20,800

Total Energy Costs ($/yr)	163,900
Total Energy Savings ($/yr)	(476,200)
Total Savings (Chemical & Stock) ($/yr)	(584,200)
Other O&M Costs ($/yr)	20,800
Total O&M Costs/Savings ($/yr)	(875,700)

C. Annual Cost-Example

3	Addition of Fourth Stage Brown Stock Washer	Cost
	Fixed Cost = 22% of $2,474,400	$ 544,400
	Maintenance = 4.5% of capital	111,300
	Added Labor	0
	Total Energy and Other O&M Costs ($/yr) (= 0 if total savings >total costs)	0
		$ 655,700

Normally, the topography of the effluent treatment site does not permit gravity flow through the entire treatment process. Consequently, it is assumed that it will be necessary to construct an effluent pumping facility that is capable of pumping the maximum daily flow of the treatment facility.

The design assumes the use of a solids-contact clarifier to accomplish flocculation, settling, and sludge removal. For flows in excess of 18,900 cubic meters per day (5 MGD), the use of two parallel units, each capable of handling 50 percent of the daily flow, is assumed.

At mills where activated sludge treatment is employed, the chemical clarification design reflects an additional solids-contact clarifier following the existing secondary clarifier. It is likely that an existing secondary clarifier could be modified to allow for the addition of chemicals; this would result in significantly lower capital expenditure. An additional clarifier allows for the recycle of biological sludge that has not been contaminated by the addition of chemicals; this would allow the addition of a chemical recovery system, if it were determined that such a system is economically advantageous.

The primary flocculant used in the design is alum. The alum dosage rate used for the purpose of cost estimates is 300 mg/l for all integrated subcategories except the groundwood-fine papers and groundwood-CMN papers subcategories. For these groundwood subcategories, the secondary fibers subcategories, and the nonintegrated-fine papers subcategory, the dosage rate is 150 mg/l. Alum tends to lower the pH of the effluent. Optimum alum flocculation is reached at a pH of 4.0 to 6.0. Provision for the addition of sulfuric acid is included to optimize alum requirements. If the effluent pH changes to a value where the effectiveness of flocculation deteriorates or the effluent does not meet pH limitations, neutralization may be required. Therefore, neutralization with sodium hydroxide is included in all cases where alum assisted clarification is considered.

Waste chemical solids from the secondary clarification process may require thickening before they can be dewatered effectively. If these solids are not thickened, the capacity of a dewatering unit is greatly reduced. Air flotation has been selected as the specific thickening process used in the development of costs. Air flotation of solids often improves when a flocculant, such as a polymer, is added to the waste solids prior to the thickening process.

Alum sludge is gelatinous and difficult to dewater. Mixing with primary sludge and/or the addition of polymer can enhance dewatering. The cost of dewatering alum sludge has been estimated assuming the use of a separate horizontal belt filter press dewatering system to dewater chemical solids only. Dewatered sludge is assumed to be landfilled.

Design criteria for the activated sludge treatment system applicable to the nonintegrated-tissue papers, nonintegrated-lightweight papers, nonintegrated-filter and nonwoven papers, and nonintegrated-paperboard subcategories are presented in Table IV-14.

Option 3. BCT Option 3 is defined as BCT Option 1 plus the addition of chemically assisted clarification for all integrated and secondary fibers subcategories and for the nonintegrated-fine papers subcategory (those subcategories for which biological treatment is the technology basis of BPT). For the remaining nonintegrated subcategories, BCT Option 3 is defined as BCT Option 1 plus the addition of biological treatment. BCT Option 3 costs, therefore, include BCT Option 1 costs plus the cost of the end-of-pipe treatment systems identical in design to those discussed in BCT Option 2; lower RWLs characteristic of Option 1, are assumed.

Option 4. For most subcategories, BCT Option 4 for conventional pollutant control is based on the levels attained by best performing mills. Best mill performance for a subcategory is generally the average performance at all mills where BPT is attained using BPT technology (see Section III). End-of-pipe treatment is biological treatment for all subcategories except the nonintegrated-tissue papers, nonintegrated-filter and nonwoven papers, nonintegrated-lightweight papers, and nonintegrated-paperboard subcategories (where end-of-pipe treatment is chemically assisted primary clarification at a dosage rate of 150 mg/l of alum). BCT Option 4 is identical to BCT Option 1 for the paperboard from wastepaper, tissue from wastepaper, wastepaper molded products, and builders' paper and roofing felt subcategories.

The design basis for the upgraded treatment systems for this option is presented in Table IV-15. Costs associated with implementation of this option are presented in Table IV-12. Tables IV-16 and IV-17 present example design parameters and cost estimate calculations for BCT Option 4 end-of-pipe treatment for a dissolving kraft mill.

ENERGY AND NON-WATER QUALITY IMPACTS

General

This section summarizes the development of the incremental energy usage and air and noise pollution associated with attaining BCT Options 1, 2, 3, and 4 relative to BPT levels. Also described are the quantities and types of solid wastes currently generated by the pulp, paper, and paperboard industry and estimated to be generated by the implementation of the BCT Options. Current, and some potential, technologies for the disposal of solid wastes are discussed. Lastly, the availability of equipment and labor necessary and the time required to implement BCT are described.

TABLE IV-14

DESIGN CRITERIA BCT OPTION 2 ACTIVATED SLUDGE FOR THE NONINTEGRATED-TISSUE PAPERS, NONINTEGRATED-LIGHTWEIGHT PAPERS, NONINTEGRATED-FILTER AND NONWOVEN PAPERS, AND NONINTEGRATED-PAPERBOARD SUBCATEGORIES

Wastewater Pumping
- Design flow: 1.3 to 2.0 x average annual flow depending on subcategory
- Basis for power cost: 12 m total dynamic head, 70% efficient

Neutralization
- Number of units: 1
- Detention time: 1 min. at peak daily flow
- Mixer: 264 hp/1000 cu m
- Dosage: 10 mg/l sodium hydroxide

Secondary Clarification
- 2 units for flows greater than 18,927 cu m/d
- Overflow rate: 20 cu m/d/sq m
- Sidewater depth: 4 m

Activated Sludge Basin
- Number of basins: 2
- Loading rate (use larger value):
  - 0.8 kg BOD_5 applied/cu m/day
  - 6 hr hydraulic detention time
- Nutrient feed: BOD_5 removed:N:P = 100:5:1

- Aeration design requirements:
  - 1 kg O_2/kg BOD_5 removed
  - 17 kg O_2/aeration hp/d
- Length/width ratio: 4/1
- Sidewater depth: 4 m
- Side slope: 1/1

Dissolved Air Flotation Thickening for Secondary Solids
- Sludge loading rate: 10 kg/hr/sq m
- Hydraulic loading rate: 46.9 cu m/d/sq m
- Chemical dosage: 4 kg of polymer/kkg of solids

Solids Dewatering
- Type: horizontal belt-filter press
- Loading rate: 318 kg of dry solids/hr/m of belt width
- Chemical dosage: 4 kg of polymer/kkg of solids

Primary/Biological Sludge Landfill
- Sludge content: primary and biological sludge at 30 percent solids (w/w)
- Landfill design: normal landfill compaction and covering techniques

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TABLE IV-15

DESIGN BASIS FOR ESTIMATES OF COSTS OF END-OF-PIPE TREATMENT FOR ATTAINMENT OF BCT OPTION 4

I. INTEGRATED SEGMENT

A. Mills with Activated Sludge Treatment Systems

1. Addition of a liquor spill collection system with shock pond.
2. Provide aeration for BPT equalization basin: 2.6 hp/1000m^3 (10 hp/mg).
3. Reduce primary clarification overflow rate from 24 to 20 $m^3/d/m^2$ (600 to 500 gpd/ft^2).
4. Increase aeration basin capacity.
    - a. 50 percent additional aeration over BPT.
    - b. 50 percent additional detention over BPT.
    - c. Includes costs to allow operation in a contact stabilization mode.
5. Reduce secondary clarification overflow rate from 20 to 16 $m^3/d/m^2$ (500 to 400 gpd/ft^2).
6. Expand solids handling system based on increase in solids production and removal over BPT levels.

B. Mills with Aerated Stabilization Basin (ASB) Treatment

1. Two options of upgrading ASB system.
    - a. Additional aeration and settling.
        - (1) Addition of a liquor spill collection system with shock pond.
        - (2) Reduce primary clarification overflow rate from 24 to 20 $m^3/d/m^2$ (600 to 500 gpd/ft^2).
        - (3) Additional 9 days of settling beyond BPT.
        - (4) Increase aeration to a total of 2.6 hp/1000 m^3 (10 hp/mg).
    - b. Conversion to activated sludge (extended aeration).
        - (1) Addition of a liquor spill collection system with shock pond.
        - (2) Reduce primary clarification overflow rate from 24 to 20 $m^3/d/m^2$ (600 to 500 gpd/ft^2).
        - (3) ASB reconfigured with earthen dikes so as to create a 12-hr equalization basin at peak flow, and a 2-day aeration basin.
        - (4) Relocate existing aerators into equalization basin.
        - (5) Install new aerators in aeration basin.
            - (a) Design basis of 1.5 kg O_2/kg BOD5 removed.
        - (6) Install a new secondary clarifier with an overflow rate of 16 $m^3/d/m^2$ (400 gpd/ft^2).
        - (7) Expand solids handling system based on increase in solids production and removal over BPT levels.

C. Mills with Oxidation Ponds.

1. Addition of mixed media filtration to control algae.
2. Design basis of 235 $m^3/d/m^2$ (4 gpm/ft^2).

TABLE IV-15 (continued)

DESIGN BASIS FOR ESTIMATES OF COSTS OF END-OF-PIPE TREATMENT FOR ATTAINMENT OF BCT OPTION 4

II. SECONDARY FIBERS SEGMENT

A. Deink Subcategories

1. Mills with activated sludge systems.
   a. Addition of a spill collection system with shock pond.
   b. Provide aeration for BPT equalization basin: 2.6 hp/1000 m^3 (10 hp/mg).
   c. Reduce primary clarification overflow rate from 24 to 20 $m^3/d/m^2$ (600 to 500 gpd/ft^2).
   d. Addition of polymer to primary clarifier: dosage at 1 mg/l.
   e. Reduce secondary clarification overflow rate from 20 to 16 $m^3/d/m^2$ (500 to 400 gpd/ft^2).
   f. Expand solids handling system based on increase in solids production and removal over BPT levels.

2. Mill with Aerated Stabilization Basin Systems.
   a. Addition of a spill collection system with shock pond.
   b. Reduce primary clarification overflow rate from 24 to 20 $m^3/d/m^2$ (600 to 500 gpd/ft^2).
   c. Addition of polymer to primary clarifier: dosage at 1 mg/l.

B. All Other Secondary Fiber Subcategories.

1. BPT end-of-pipe treatment.
2. BCT Option 1 internal controls.

III. NONINTEGRATED SEGMENT

A. Fine Papers Subcategory

1. Mills with activated sludge treatment systems.
   a. Provide aeration for BPT equalization basin: 2.6 hp/1000 m^3 (10 hp/mg).
   b. Reduce primary clarification overflow rate from 24 to 20 $m^3/d/m^2$ (600 to 500 gpd/ft^2).
   c. Increase aeration basin capacity.
      (1) 50 percent additional aeration over BPT.
      (2) 50 percent additional detention over BPT.
      (3) Includes costs to allow operation in a contact stabilization mode.
      (4) Reduce secondary clarification overflow rate from 20 to 16 $m^3/d/m^2$ (500 to 400 gpd/ft^2).
      (5) Expand solids handling system based on increase in solids production and removal over BPT levels.

TABLE IV-15 (continued)

DESIGN BASIS FOR ESTIMATES OF COSTS OF END-OF-PIPE TREATMENT FOR ATTAINMENT OF BCT OPTION 4

III. NONINTEGRATED SEGMENT (continued)

2. Mills with aerated stabilization basin treatment.
   a. Addition of 12 hours of equalization at peak flow.
   b. Reduce primary clarification overflow rate from 24 to 20 $m^3/d/m^2$ (600 to 500 gpd/ft^2).
   c. Addition of 1 day of quiescent settling.
   d. Increase of aeration to 2.6 hp/1000 m^3 (10 hp/mg).

B. All Other Nonintegrated Subcategories

1. Additional clarification to decrease overflow rate from 24 to 16 $m^3/d/m^2$ (600 to 400 gpd/ft^2).
2. Addition of chemically assisted clarification (flash mixing prior to clarifiers).
3. Expand solids handling system based on increase in solids production over BPT.

TABLE IV-16

DESIGN PARAMETERS FOR BCT OPTION 4
EXAMPLE CALCULATION

907 kkg/d Dissolving Kraft Mill

Effluent Guidelines:	BPT	BCT
Flow (kl/kkg)	229.9	229.9
BOD5 (kg/kkg)	6.9	4.6
TSS (kg/kkg)	11.05	6.5

Design Parameters:

Flow: 907 kkg/d x 229.9 kl/kkg x m^3/kl = 208,500 m^3/d

BOD5 Removed: 907 kkg/d x (6.9 kg/kkg - 4.6 kg/kkg) = 2086 kg/d

Biological Solids Produced:

Assuming 32 percent of BOD5 removed becomes solids:

907 kkg/d x [0.32 x (6.9 kg/kkg-4.6 kg/kkg)] = 668 kg/d

Assuming all of TSS removed becomes solids:

907 kkg/d x (11.05 kg/kkg-6.5 kg/kkg) = 4,127 kg/d

Total solids removed: 668 kg/d + 4,127 kg/d = 4,795 kg/d

TABLE IV-17

COST SUMMARY FOR BCT OPTION 4 ACTIVATED SLUDGE SYSTEM MODIFICATION UNIT PROCESS END-OF-PIPE TREATMENT EXAMPLE CALCULATION

907 kkg/d Dissolving Kraft Mill

Treatment	Capital ($1,000)	Amortized Capital ($1,000/yr)	Operation and Maintenance ($1,000/yr)	Energy ($1,000/yr)	Total Annual ($1,000)
Process Spill Collection System	320	70	10	31	111
Spill Basin	63	14	1	0	15
Pumping from Spill Basin	35	8	1	1	10
Spill Neutralization	53	12	7	0	19
Aeration in Equalization Basin (peaking factor - 1.3)	257	57	23	75	155
Primary Clarifier Modification	847	186	25	48	259
Activated Sludge Basin Modification	1,816	400	41	0	441
Additional Aeration	1,278	281	40	391	712
Secondary Clarifier Modification	2,028	446	51	35	532
Nutrient Addition	0	0	19	0	19
Flotation Polymer	0	0	38	0	38
Flotation Thickening	645	142	36	8	186
Dewatering Polymer	0	0	38	0	38
Horizontal Belt-Filter	645	142	26	4	172
Primary and Biological Sludge Transportation	0	0	124	0	124
Primary and Biological Sludge Landfill	138	30	43	0	73
Subtotal	8,126	1,788	522	593	2,903

Energy Requirements

EPA anticipates that some of the various control and treatment options considered as the basis of final rules could affect existing energy demand. Estimates of the energy requirements of each specific technology option are presented in this section. In some cases, the implementation of production process controls may result in a net energy saving. It is possible that, even where net heat energy savings are achieved, energy costs can increase because of the relative amounts of fuels and electricity used and their prices.

EPA determined total energy usage prior to implementation of the various technology options, or the baseline energy usage, based on data in the American Paper Institute monthly energy reports. Average power and fuel usages were determined from information obtained as a result of the data request program. An energy balance was developed for each model mill; the balance takes into account the energy of spent liquor and hogged fuel, if appropriate.

Table IV-18 presents an estimate of energy usage at direct discharging mills for the base case (attainment of BPT effluent limitations) and for the BCT Options 1, 2, 3, and 4. Total energy is presented in heat energy units (Btu). In order to account properly for energy requirements of each alternative, EPA converted electrical energy (kwh) to heat energy (Btu) at a conversion of 10,500 Btu/kwh, which reflects the average efficiency of electrical power generation.

Air Pollution

Most of the production process controls identified in BCT Option 1 are expected to have little direct impact on air emissions. However, if additional steam is required, some increase in sulfur dioxide generation could occur. Such an increase would be directly proportional to the increased boiler firing rate and the sulfur content of the fuel used. This situation is not unique to the pulp, paper, and paperboard industry, but exists for all industrial categories. Air pollution control techniques are available to minimize such increases.

Production process controls that help retain more spent liquor in the liquor recovery cycle include improved brown stock washing, decker filtrate reuse, use of blow condensates, neutralization of spent sulfite liquor before evaporation, and more complete use of evaporator condensates. These controls tend to retain more sulfur-containing compounds in the liquor system. Emissions can increase as sulfur levels increase with total liquor solids to recovery. Using modern recovery systems of adequate capacity, atmospheric emission levels of mercaptans, hydrogen sulfide, and other compounds would not increase beyond allowable limits. Generally, the normal variations in firing rates, sulfidity, and liquor solids have a greater effect than implementation of the production process controls considered.

TABLE IV-18
ENERGY USAGE AT EXISTING DIRECT DISCHARGING MILLS THROUGH IMPLEMENTATION OF BCT OPTIONS[1]

		Net Energy Usage (10^9 Btu/yr)			
Subcategory	Baseline[2]	Option 1	Option 2	Option 3	Option 4
Integrated Segment					
Dissolving Kraft	50,538	-625	263	-383	707
Market Bleached Kraft	68,856	-177	569	335	1,598
BCT Bleached Kraft	87,326	-108	461	292	1,606
Alkaline-Fine[3]	128,775	-4,714	570	-4,253	1,609
Unbleached Kraft					
o Linerboard	139,382	-1,828	431	-1,480	937
o Bag	86,048	51	118	160	288
Semi-Chemical	51,786	-1,181	297	-1,000	746
Unbleached Kraft and Semi-Chemical	124,954	-723	385	399	1,014
Dissolving Sulfite Pulp	40,529	786	305	1,043	1,276
Papergrade Sulfite[4]	56,305	-2,844	300	-2,589	854
Groundwood-Thermo-Mechanical	3,628	--	--	--	--
Groundwood-CMN Papers	9,061	-968	57	-923	124
Groundwood-Fine Papers	17,301	-771	128	-672	188
Secondary Fibers Segment					
Deink					
o Fine Papers	3,486	-268	31	-251	30
o Tissue Papers	8,715	-871	201	-729	127
o Newsprint	--	--	--	--	--
Tissue From Wastepaper	2,634	-62	40	-31	-62
Paperboard From Wastepaper[5]	30,725	-3,024	177	-2,912	-3,024
o Noncorrugating Medium Furnish	--	--	111	--	--
o Corrugating Medium Furnish	--	--	--	--	--
Wastepaper-Molded Products	1,345	-245	20	-235	-245
Builders' Paper and Roofing Felt	1,705	-308	27	-296	-308
Nonintegrated Segment					
Nonintegrated-Fine Papers[5]	27,947	-273	160	-156	232
o Wood Fiber Furnish	--	-268	149	-160	217
o Cotton Fiber Furnish	--	-5	11	4	15
Nonintegrated-Tissue Papers	7,639	-25	92[6]	54[6]	33
Nonintegrated-Lightweight Papers[5]	6,777	-753	110[6]	-661[6]	41
o Lightweight	--	-722	104[6]	-636[6]	38
o Electrical	--	-31	6[6]	-25[6]	3
Nonintegrated-Filter and Nonwoven Papers	796	-121	29[6]	-97[6]	9
Nonintegrated-Paperboard	1,362	-57	22[6]	-37[6]	6
Total	957,620	-19,109	4,793	-15,220	7,786
Residual Fuel Oil (10^6 barrels/yr)	152	-3.0	0.8	-2.4	1.2
Percent of Baseline Energy	--	-2.0	0.5	-1.6	0.8

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[1] Minus sign indicates a net energy savings.

[2] Baseline energy use is based on data contained in API monthly energy reports and BPT Development Documents.

[3] Includes Fine Bleached Kraft and Soda subcategories.

[4] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories.

[5] Totals are sums of energy use for subcategory sectors.

[6] Energy use is calculated for activated sludge treatment systems for northern facilities and aerated stabilization basins for southern facilities.

Noise Potential

There is no identifiable potential for substantially increased noise associated with any of the control and treatment options considered. Existing effluent treatment processes are not a significant source of noise.

Solid Waste Generation

A study by Energy Resources Company quantified the various solid wastes generated in 1977 in the pulp, paper, and paperboard industry.(29) In addition to sludge generated as a result of wastewater treatment, other types of solid wastes generated by this industry include chemical ash, pulping wastes, and wood wastes.

The kraft and sulfite processes produce the majority of chemical pulping wastes, consisting of green liquor dregs, lime wastes (slaker rejects and unburned rejects from lime kilns), and cooking chemical recovery process wastes. Green liquor dregs are normally sewered and, therefore, are unlikely to be included in wastewater sludge estimates. Lime wastes and recovery wastes (normally oxides of the cooking chemical base from the sulfite process) were estimated to be 535,000 metric tons (589,000 tons) in 1977.(29)

About 2,700,000 metric tons (3,000,000 tons) of landfilled bark and wood waste and approximately 1,000,000 metric tons (1,100,000 tons) of coal ash were generated in 1977.(29)

Miscellaneous pulp, paper, and paperboard industry solid waste included 1,700,000 metric tons (1,900,000 tons) of wastepaper reclamation waste (i.e., strapping, dirt, metal, and ink) in 1977. Other wastes include evaporator residue and tall oil residue; these are generated in insignificant quantities compared to other solid wastes. Total 1977 process solid waste excluding wastewater treatment sludge was about 5,900,000 metric tons (6,500,000 tons).

In a 1974 study, it was estimated that pulp, paper, and paperboard industry personnel generated about 0.23 kg (0.5 lb) of refuse per employee per shift, resulting in a total annual industry generation rate of 16,600 metric tons (18,300 tons). (48) This source of solid waste is insignificant compared to process-related sources.

Wastewater treatment facilities produce both primary and biological sludges that are usually dewatered prior to disposal. The amount of wastewater treatment sludge generated depends on a number of conditions including: (a) raw waste characteristics, (b) the existence, efficiency, and/or type of primary treatment, (c) the type of biological treatment system employed, and (d) the efficiency of biological solids removal from the wastewater. Installation of chemically assisted clarification is expected to have a significant impact on the amount of wastewater sludge generated. To assess this impact, the amount of primary and biological sludges generated at each model mill in each subcategory has been estimated. The amount of additional sludge resulting from implementation of chemically assisted clarification has also been estimated. EPA estimated the amount of primary and biological sludges generated at direct discharging mills in each subcategory. These estimates were based on sludge production criteria outlined in Section VII of the December 1980 Development Document.(1)

Table IV-19 presents an estimate of solid wastes generated at direct discharging mills for the base case (attainment of BPT effluent limitations) and for BCT Options 1, 2, 3, and 4.

Acceptable techniques for solid waste disposal include incineration, composting, pyrolysis - gasification, and landfill. McKeown reported that, in 1975, about 10 percent of wastewater sludges were incinerated and about 85 percent were disposed of by land application.(33) Incineration is a preferred method for disposal of organic wastes with low moisture content such as log sorting and mill yard wastes.

The potential exists for recovery of chemical coagulants (e.g., alum) used for effluent clarification. However, at this time an economical recovery technology has not been employed on a full-scale basis. Should technology become available to recover and reuse alum economically, chemically assisted clarification would become less expensive and sludge disposal requirements would be reduced.

Composting is a technology that theoretically could be applied to pulp, paper, and paperboard mill wastewater treatment sludges. Through proper composting, sludge can be converted to non-pathogenic organic material that may be used as a soil conditioner.

Pyrolysis-gasification may play a future role in solid waste disposal. Commercial-scale units have yet to be used for which economic effectiveness has been proven or from which operating experience has been obtained.

Land application of wastewater treatment plant sludges can be a viable disposal option. Sludge can be applied to a field that will be used for agricultural production. The organic nutrients and sludge bulk can serve to increase crop production. A prerequisite for the technique is that adequate and suitable land will be available within a reasonable proximity of the plant.

Landfills are the most prevalent means of solid waste disposal in the industry. The primary environmental problem associated with landfill disposal of wastewater sludges is the potential for leachate contamination of ground and surface waters.

TABLE IV-19

TOTAL WASTEWATER SOLID GENERATION AT EXISTING DIRECT DISCHARGING MILLS THROUGH IMPLEMENTATION OF BCT OPTIONS

	Wastewater Solid Waste Generation (1,000 kkg/yr)					
	Baseline[1]		BCT	BCT	BCT	BCT
Subcategory	Primary	Biological	Option 1	Option 2[2]	Option 3[2]	Option 4
Integrated Segment						
Dissolving Kraft	96.1	37.3	0.0	24.4	23.0	1.8
Market Bleached Kraft	95.6	47.7	0.0	52.5	44.6	14.0
BCT Bleached Kraft	143.1	54.7	0.0	43.6	37.9	21.0
Alkaline-Fine[2]	219.5	71.7	0.0	52.0	40.4	22.9
Unbleached Kraft						
o Linerboard	109.1	47.7	0.0	38.6	28.0	4.1
o Bag	29.7	13.1	0.0	10.5	9.3	1.0
Semi-Chemical	26.8	25.9	0.0	27.1	18.7	6.7
Unbleached Kraft and Semi-Chemical	77.5	39.5	0.0	60.3	48.3	5.5
Dissolving Sulfite Pulp	58.4	55.3	0.0	53.0	41.6	10.7
Papergrade Sulfite[3]	106.8	58.5	0.0	49.4	40.4	10.9
Groundwood-Thermo-Mechanical	--	--	--	--	--	--
Groundwood-CMN Papers	19.4	5.3	0.0	2.6	2.2	0.6
Groundwood-Fine Papers	48.3	12.2	0.0	5.6	4.6	1.9
Secondary Fibers Segment						
Deink						
o Fine Papers	35.4	7.6	0.0	1.5	0.8	2.2
o Tissue Papers	114.0	23.9	0.0	5.9	3.4	3.3
o Newsprint	--	--	--	--	--	--
Tissue From Wastepaper	10.1	1.5	0.0	0.8	0.5	0.0
Paperboard From Wastepaper	15.1	4.8	0.0	11.1	5.4	0.0
o Noncorrugating Furnish	--	--	--	--	--	--
o Corrugating Furnish	--	--	--	--	--	--
Wastepaper-Molded Products	0.7	0.2	0.0	0.4	0.1	0.0
Builders' Paper and Roofing Felt	4.9	1.1	0.0	0.5	0.2	0.0
Nonintegrated Segment						
Nonintegrated-Fine Papers	32.4	6.2	0.0	5.8	3.3	1.8
o Wood Fiber Furnish	--	--	--	--	--	--
o Cotton Fiber Furnish	--	--	--	--	--	--
Nonintegrated-Tissue Papers	10.2	--	0.0	0.0	0.0	1.8
Nonintegrated-Lightweight						
o Lightweight	8.5	--	0.0	0.0	0.0	1.9
o Electrical	0.4	--	0.0	0.0	0.0	0.1
Nonintegrated-Filter and Nonwoven Papers	0.6	--	0.0	0.0	0.0	0.4
Nonintegrated-Paperboard	2.1	--	0.0	0.0	0.0	0.2
Total	1264.7	514.2	0.0	445.6	352.7	112.8
Percent of Baseline Wastewater Solid Waste	--	--	0.0	25.0	19.8	6.3
Percent of baseline total solid waste	--	--	0.0	5.7	4.5	1.4

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[1] Baseline wastewater solid waste production is based on estimated BPT raw waste loads; baseline solid waste other than wastewater solids is 6,016,600 kkg/yr.

[2] Includes Fine Bleached Kraft and Soda subcategories.

[3] Includes Papergrade Sulfite (Blow Pit Wash) and Papergrade Sulfite (Drum Wash) subcategories.

Environmental safety procedures and knowledge of proper landfilling practices have increased widely in recent years. EPA has established operating and design criteria for several landfill techniques for sludges ranging from 20 to 30 percent solids. These techniques include area fill layer, area fill mound, diked containment, narrow trench, wide trench, co-disposal with soil, and co-disposal with refuse.

Implementation Requirements

This section describes the availability of equipment and labor necessary to implement BCT Options 1, 2, 3, and 4, and the time required to effect the implementation.

Availability of Equipment. EPA expects that present manufacturing capabilities are such that required equipment can be readily produced. Any increased demand for either production process control equipment or wastewater treatment equipment should be met without major delays. No geographical limitations are anticipated because of the ability of this industry to use local independent contractors for fabrication of certain pieces of equipment.

Availability of Labor Force. Manpower necessary for implementation of technology alternatives could come from two sources: a) mill personnel and b) outside contractors. On jobs that cannot be completed during a normal shut-down or are considered too complex for mill personnel, an outside contractor can be hired to perform the necessary tasks.

A Bureau of Labor Statistics study concluded that the availability of construction laborers to perform the required work is sufficient.(34) This availability is based on two major factors. The first is the short training time that is required for construction labor (6 to 12 months), and the second is the willingness of construction labor to relocate. Therefore, availability of labor is not anticipated to be a problem in implementing the technology alternatives.

Implementation Time. The production process controls considered do not involve major process changes. Therefore, any implementation of production process controls could be accomplished in scheduled shut-down periods. Additional time is available for completion of certain projects during routine maintenance and clean-up, typically done every two to three weeks.

For end-of-pipe treatment facilities, normal construction techniques and crews would be required. The bar graph presented in Figure IV-1 shows the estimated time required to implement the BCT Option 2 and 3 technologies, respectively. It is anticipated that the time required for implementation of BCT Option 4 technology would be comparable to that required for implementation of the end-of-pipe technology considered in BCT Options 2 and 3. However, due to the wide variety of treatment

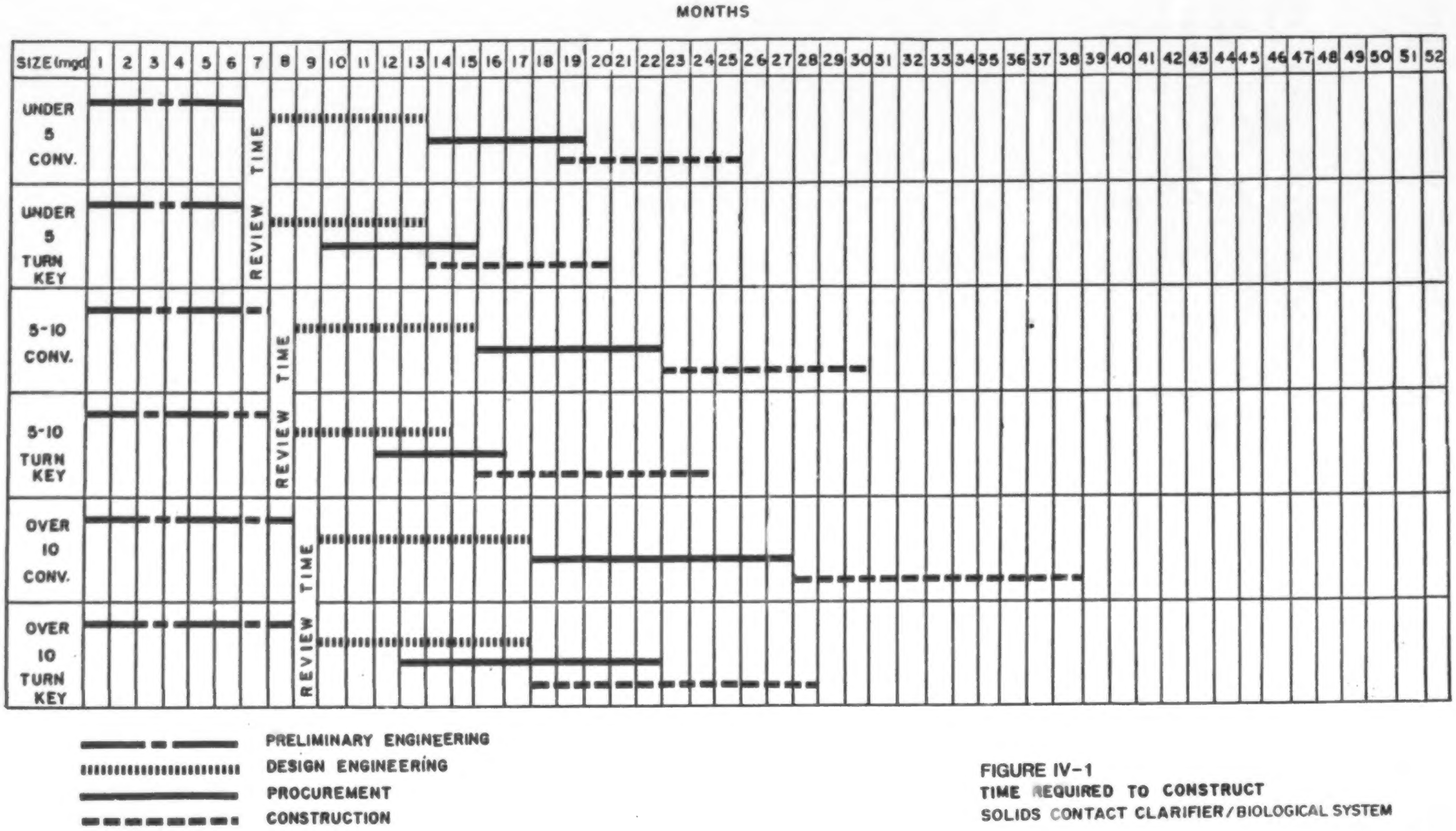

FIGURE IV-1
TIME REQUIRED TO CONSTRUCT
SOLIDS CONTACT CLARIFIER/BIOLOGICAL SYSTEM

schemes employed at mills in the industry, implementation time is expected to vary from mill to mill.

Other Considerations

Benefits other than improved water quality can result from production process technology modification. As noted earlier, these benefits include savings resulting from improved raw material usage and better operating efficiency. The economic saving associated with these benefits have been estimated and are presented in Table IV-4. Improved by-product recovery may also result; however, no estimates of savings resulting from by-product recovery have been included in the cost estimates presented previously.

SECTION V

EFFLUENT REDUCTION ATTAINABLE THROUGH THE APPLICATION OF BEST CONVENTIONAL POLLUTANT CONTROL TECHNOLOGY EFFLUENT LIMITATIONS GUIDELINES

GENERAL

The 1977 amendments added section 301(b)(2)(E) to the Act, establishing "best conventional pollutant control technology" (BCT) for discharges of conventional pollutants from existing industrial point sources. Conventional pollutants are those defined in section 304(a)(4) (biological oxygen demanding pollutants (BOD5), total suspended solids (TSS), fecal coliform, and pH), and any additional pollutants defined by the Administrator as "conventional" (oil and grease; 44 FR 44501, July 30, 1979).

BCT is not an additional limitation but replaces BAT for the control of conventional pollutants. In addition to other factors specified in section 304(b)(4)(B), the Act requires that BCT limitations be assessed in light of a two part "cost-reasonableness" test. The first test compares industry's cost for reducing its conventional pollutants to the cost of publicly owned treatment works (POTWs) for similar levels of conventional pollutant reduction. The second test examines the cost-effectiveness of additional industrial treatment beyond BPT. EPA must find that limitations are "cost-reasonable" under both tests before establishing them as BCT. In no case may BCT be less stringent than BPT.

EPA originally published a methodology for carrying out the BCT cost test on August 29, 1979 (44 FR 50732). Using that methodology, BCT effluent limitations were proposed for the pulp, paper, and paperboard industry on January 6, 1981 (46 FR 1430). However, EPA was later ordered by the Court of Appeals for the Fourth Circuit to correct data and methodological errors in its BCT cost test and to develop a new BCT methodology (see *American Paper Institute* v. *EPA*, 660 F.wd 954 (4th Cir. 1981)). Revised BCT limitations were reproposed along with the revised BCT methodology on October 29, 1982 (47 FR 49176). The Agency then issued its final BCT methodology on July 9, 1986 (see 51 FR 24974).

REGULATED POLLUTANTS

Pollutants regulated under BCT are BOD5, TSS, and pH.

IDENTIFICATION OF THE BEST CONVENTIONAL POLLUTANT CONTROL TECHNOLOGY

The best conventional pollutant control technology is the same as the best practicable control technology currently available (BPT) for each subcategory. BPT limitations are based on biological treatment or primary clarification (for some nonintegrated segment subcategories).

BCT EFFLUENT LIMITATIONS

BCT effluent limitations are presented in Table V-1.

The Agency developed costs and pollutant removals for four candidate technologies that were evaluated as potential bases for BCT effluent limitations. EPA then applied to these candidate technologies the two-part BCT cost test. None of the candidate technologies for any subcategory in the pulp, paper, and paperboard industry passes the Agency's BCT cost test. Therefore, BCT effluent limitations guidelines for each subcategory are set equal to BPT effluent limitations guidelines.

COST OF APPLICATION AND EFFLUENT REDUCTION BENEFITS

Since none of the candidate technologies considered for BCT effluent limitations guidelines for the pulp, paper, and paperboard industry pass the BCT cost test, BCT effluent limitations are set equal to the BPT effluent limitations guidelines for each subcategory. As a result, no incremental costs are associated with these BCT regulations.

NON-WATER QUALITY ENVIRONMENTAL IMPACTS

Sections 304(b) and 306 of the Act require EPA to consider the non-water quality environmental impacts (including air pollution, solid waste generation, and energy requirements) of certain regulations. In conformance with these provisions, EPA considered the effect of this regulation on air pollution, solid waste generation, and energy consumption. However, since the BCT effluent limitations guidelines are being set equal to the BPT effluent limitations guidelines, no incremental non-water quality impacts are associated with these regulations.

TABLE V-I
BCT EFFLUENT LIMITATIONS
CONTINUOUS DISCHARGERS
(kg/kkg or lbs/1000lbs)

Subcategory	Maximum 30-Day Average		Maximum Day		pH Range[1]
	BOD5	TSS	BOD5	TSS	
Integrated Segment					
Dissolving Kraft	12.25	20.05	23.6	37.3	5.0-9.0
Market Bleached Kraft	8.05	16.4	15.45	30.4	5.0-9.0
BCT Bleached Kraft	7.1	12.9	13.65	24.0	5.0-9.0
Alkaline-Fine[2]					
o Fine Bleached Kraft	5.5	11.9	10.6	22.15	5.0-9.0
o Soda	7.1	13.2	13.7	24.5	5.0-9.0
Unbleached Kraft					
o Linerboard	2.8	6.0	5.6	12.0	6.0-9.0
o Bag	2.8	6.0	5.6	12.0	6.0-9.0
Semi-Chemical	4.35	5.5	8.7	11.0	6.0-9.0
Unbleached Kraft and Semi-Chemical	4.0	6.25	8.0	12.5	6.0-9.0
Dissolving Sulfite Pulp					
o Nitration	21.5	38.05	41.4	70.65	5.0-9.0
o Viscose	23.0	38.05	44.3	70.65	5.0-9.0
o Cellophane	24.95	38.05	48.05	70.65	5.0-9.0
o Acetate[3]					
Papergrade Sulfite (Blow Pit Wash)					
o Bisulfite-Surface	16.55	23.65	31.8	43.95	5.0-9.0
o Bisulfite-Barometric	18.05	28.1	34.7	52.2	5.0-9.0
o Acid Sulfite - Surface	16.8	23.65	32.3	43.95	5.0-9.0
o Acid Sulfite - Barometric	18.5	28.1	35.55	52.2	5.0-9.0
Papergrade Sulfite (Drum Wash)					
o Bisulfite-Surface	13.9	23.65	26.7	43.95	5.0-9.0
o Bisulfite-Barometric	15.3	28.1	29.4	52.2	5.0-9.0
o Acid Sulfite-Surface	15.5	23.65	29.75	43.95	5.0-9.0
o Acid Sulfite-Barometric	16.9	28.1	32.5	52.2	5.0-9.0
o Continuous Digesters	19.85	28.95	38.15	53.75	5.0-9.0
Groundwood-Thermo-Mechanical[4]					
Groundwood-CMN Papers	3.9	6.85	7.45	12.75	5.0-9.0
Groundwood-Fine Papers	3.6	6.3	6.85	11.75	5.0-9.0
Secondary Fibers Segment					
Deink					
o Fine Papers	9.4	12.95	18.1	24.05	5.0-9.0
o Tissue Papers	9.4	12.95	18.1	24.05	5.0-9.0
o Newsprint	9.4	12.95	18.1	24.05	5.0-9.0
Tissue From Wastepaper	7.1	9.2	13.7	17.05	5.0-9.0
Paperboard From Wastepaper					
o Corrugating Medium Furnish	2.8	4.6	5.7	9.2	6.0-9.0
o Noncorrugating Medium Furnish	1.5	2.5	3.0	5.0	6.0-9.0
Wastepaper-Molded Products	2.3	5.8	4.4	10.8	5.0-9.0
Builders' Paper and Roofing Felt[5]	3.0	3.0	5.0	5.0	6.0-9.0
Nonintegrated Segment					
Nonintegrated-Fine Papers					
o Wood Fiber Furnish	4.25	5.9	8.2	11.0	5.0-9.0
o Cotton Fiber Furnish	9.1	13.1	17.4	24.3	5.0-9.0
Nonintegrated-Tissue Papers	6.25	5.0	11.4	10.25	5.0-9.0
Nonintegrated-Lightweight Papers					
o Lightweight	13.2	10.6	24.1	21.6	5.0-9.0
o Electrical	20.9	16.7	38.0	34.2	5.0-9.0
Nonintegrated-Filter and Nonwoven Papers	16.3	13.0	29.6	26.6	5.0-9.0
Nonintegrated-Paperboard	3.6	2.8	6.5	5.8	5.0-9.0

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[1] pH shall be within the indicated range at all times.

[2] Includes fine bleached kraft and soda subcategories.

[3] BPT limitations for acetate grade production in the dissolving sulfite pulp subcategory have been remanded by the Court of Appeals. Limitations have not yet been promulgated.

[4] BCT effluent limitations for the groundwood-thermo-mechanical pulp subcategory have not yet been established.

[5] In addition to the above limitations settleable solids are not to exceed 2.0 ml/l.

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